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FINAL REPORT

RESEARCH STUDY ON NEUTRAL THERMODYNAMIC ATMOSPHERIC MODEL

by

W.R. Hargraves, E.B. Delulio, and C.G. Justus

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**NASA George C. Marshall Space Flight Center
Marshall Space Flight Center, AL 35812**

Contract NAS8-30657

January 1977

**SCHOOL OF AEROSPACE ENGINEERING
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GA 30332**



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THERMODYNAMIC ATMOSPHERIC MODEL

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Abstract

The Global Reference Atmospheric Model as developed and reported in NASA TMX-64871 and 64872 is used along with the revised perturbation statistics (January 1975 report on Contract NAS8-30657) to evaluate and computer graph various atmospheric statistics along a Space Shuttle Reference Mission and Abort Trajectory furnished by NASA. The trajectory plots are height vs. ground range, with height from ground level to 155 km and ground range along the re-entry trajectory.

Cross-sectional plots, height vs. latitude or longitude, are also generated for 80° longitude, with heights from 30 km to 90 km and latitude from -90° to +90°, and for 45° latitude, with heights from 30 km to 90 km and longitudes from 180° E to 180° W.

The variables plotted are monthly average pressure, density, temperature, wind components, and wind speed and standard deviations and 99th inter-percentile range for each of these variables.

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| Jan/ July | Apr/ Oct | | January | | April | | July | | October | | January | | | | | April | July | | | | | Oct. |
| | | | Long. | Long. | Long. | Long. | Long. | Long. | Long. | Long. | Alt. | Alt. | H.S.A.* | A.S.A.† | L.S.A.‡ | Alt. | Alt. | Alt. | H.S.A. | A.S.A. | L.S.A. | Alt. |
| | | | 0-180 | -180-0 | 0-180 | -180-0 | 0-180 | -180-0 | 0-180 | -180-0 | 0-30 | 30-90 | 90-155 | 90-155 | 90-155 | 30-90 | 0-30 | 30-90 | 90-155 | 90-155 | 90-155 | 30-90 |
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*H.S.A. High Solar Activity †A.S.A. Average Solar Activity ‡L.S.A. Low Solar Activity

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1. INTRODUCTION

Under a previous contract (NAS8-29753) an extended four Dimensional (height, latitude, longitude, and month-by-month variation) Global Reference Atmospheric Model for surface to orbital altitudes has been developed and tested at Georgia Tech. The Global Reference Atmospheric Model combines: 1) the NASA 4-D worldwide atmospheric model (0 - 25 km) developed by Allied Research Associates (NASA CR-2082), 2) the Jacchia 1970 model (Smithsonian Astrophysical Observatory Space Report 313) for the thermosphere above 90 km, and 3) the Groves model (AD 737 794) for latitude and longitude dependent stationary perturbations developed at Georgia Tech from readings of 10 mb, 2 mb, and 0.4 mb map data and extrapolations to 90 km by the method developed for NASA by Northrop (NASA CR-2223).

In addition to the monthly means, quasi-biennial and random perturbations in pressure, density, temperature, and winds are evaluated. The quasi-biennial amplitudes and phase were determined at Georgia Tech from analysis of Meteorological Rocket Network data from 1964 through 1969 (Justus and Woodrum, NASA CR-2203) and from literature reports of other investigators.

The Global Reference Atmospheric Model as developed and reported in NASA TMX-64871 and 64872 is used, along with the revised perturbation statistics (January 1975 report on Contract NAS8-30657) to evaluate and computer graph various atmospheric statistics along a Space Shuttle Reference Mission and Abort Model Trajectory furnished by NASA. The trajectory plots are height vs. ground range, with height from ground level to 155 km, and ground range along the re-entry trajectory. The 30 km to 90 km height range is plotted for January, April, July and October and the 0 km to 30 km height range for January and July. The 90 km to 155 km height range is

plotted for January and July for high, average, and low levels of solar activity.

Cross-sectional plots, height vs. latitude or longitude, are also developed for 80° longitude, with heights from 30 km to 90 km and latitude from -90° to $+90^\circ$, and for 45° latitude, with heights from 30 km to 90 km and longitudes from 180° E to 180° W. These cross-sections were plotted for January, April, July, and October. The variables plotted are monthly average pressure, density, temperature, wind components, and wind speed and standard deviation and 99th inter-percentile range for each of these variables.

2. DESCRIPTION OF THE PLOT PROCEDURE

The plot program which was developed under the present contract will generate a plot of any of twelve different variables against a selection of x and y axis parameters. It requires as input a data file, which is generated by GRAM at appropriate locations; one input card for each variable to be plotted; and, if a range plot is to be generated, a range input file, which contains the range and corresponding time and is used to label the time axis and mark the line of the trajectory.

The input card for each plot contains the following parameters:

| <u>Parameter</u> | <u>Definition</u> |
|------------------|---|
| IX | the parameter for the x axis |
| IY | the parameter for the y axis |
| IP | the parameters to be plotted |
| CONT(1) | Contour value for the first plot parameter |
| CONT(2) | Contour value for the second plot parameter |
| LOC | the value, in degrees, of the latitude/longitude for a height vs. longitude/latitude plot |
| KON | specifies whether latitude or longitude is held constant for a height vs. latitude/longitude plot. LOC and KON are used to label the plot |
| IDELTA(7) | incremental change along range axis, km |
| LIMITS(7) | number of data values along the range axis minus 1 |
| LEN(7) | length of range axis, inches |
| INITIAL(7) | initial value of range - used in labeling range axis. IDELTA(7), LIMITS(7), LEN(7), and INITIAL(7) are input only for ground range plots |
| ISOL | solar activity parameter used to label plot. 1. high solar activity, 2. average solar activity, 3. low solar activity |

The following values are permissible for IX and IY on the input card
(Note the axis associated with that value):

| <u>IX or IY</u> | <u>Definition</u> | <u>Axis</u> |
|-----------------|---------------------------------|-------------|
| 1 | Latitude -90 to +90 | x - axis |
| 2 | Latitude -90 to +90 | y - axis |
| 3 | Height 0 to 30 | y - axis |
| 4 | Height 30 to 90 | y - axis |
| 5 | Height 90 to 155 | y - axis |
| 6 | Height 155 to 200 | y - axis |
| 7 | Ground range "input" to "input" | x - axis |
| 8 | Longitude 180 to 0 | x - axis |
| 9 | Longitude 0 to -180 | x - axis |

The plot parameter, IP, values can be selected from the following list:

| <u>Value</u> | <u>Definition</u> |
|--------------|--|
| 1 | Pressure (% deviation from U.S. Standard) and standard deviation of pressure (% relative to GRAM monthly mean) |
| 2 | Density (% deviation from U.S. Standard) and standard deviation of density (% relative to GRAM monthly mean) |
| 3 | Temperature and standard deviation of temperature ($^{\circ}$ K) |
| 4 | Geostrophic monthly mean and standard deviation of eastward wind (m/s) |
| 5 | Geostrophic monthly mean and standard deviation of northward wind (m/s) |
| 6 | Wind speed and standard deviation of wind speed (m/s) |
| 7 | Upper and lower 99 th percentile of pressure (% deviation from U.S. Standard) |
| 8 | Upper and lower 99 th percentile of density (% deviation from U.S. Standard) |
| 9 | Upper and lower 99 th percentile of temperature ($^{\circ}$ K) |
| 10 | Upper and lower 99 th percentile of eastward wind (m/s) |
| 11 | Upper and lower 99 th percentile of northward wind (m/s) |
| 12 | Upper and lower 99 th percentile of wind speed (m/s) |

The first parameter for each IP value appears as a solid line on the plot and the second parameter appears as a dashed line.

The data values used to plot pressure, density, temperature, standard deviation of pressure and standard deviation of density are taken directly from the GRAM output without change. The standard deviation of temperature is changed from % relative to GRAM monthly mean to ° K by:

$$\sigma_T = (T)(\%_T)/100 \quad \text{where} \quad \begin{array}{l} \sigma_T - \text{standard deviation of temperature } ^\circ \text{K} \\ T - \text{GRAM monthly mean} \\ \%_T - \% \text{ relative to GRAM monthly mean, as output by GRAM.} \end{array}$$

The wind components and their standard deviation are in m/s as output by GRAM.

The wind speed and standard deviation are calculated as follows:

$$\begin{array}{ll} (1) & S_W = \sqrt{\bar{u}^2 + \bar{v}^2} \quad \text{where} \quad \begin{array}{l} S_W - \text{wind speed} \\ \bar{u} - \text{mean eastward wind} \\ \bar{v} - \text{mean northward wind} \end{array} \\ (2) & \sigma_{S_W} = \sqrt{\sigma_u^2 + \sigma_v^2} \quad \text{where} \quad \begin{array}{l} \sigma_{S_W} - \text{standard deviation of wind speed} \\ \sigma_u - \text{standard deviation of eastward wind} \\ \sigma_v - \text{standard deviation of northward wind} \end{array} \end{array}$$

Note that the wind speed defined by (1) is the magnitude of the resultant wind and is neither the average, nor the median (50%) wind speed.

The 99th percentile values for pressure and density are in percent deviation from the standard atmosphere as follows:

$$(3) \quad Z_{99} = Z \pm 2.326 \sigma_Z$$

Z_{99} - 99th percentile value
 Z - GRAM monthly mean
 σ_Z - standard deviation of GRAM monthly mean

Note that, due to the distinct non-Gaussian nature of the wind speed distribution, equation (3) does not actually give the 99th inter-percentile wind speeds (1 percentile speeds computed as less than zero by (3) are taken to be zero). From Appendix A, equation (3) should give approximately the 99.6% inter-percentile wind speed.

The percent deviations are obtained by:

$$\%_{99} = \frac{Z_{99} - Z_s}{Z_s} \times 100 \quad \text{where} \quad Z_s - \text{standard atmosphere value}$$

$\%_{99}$ - the respective 99th percentile value in percent deviation from U.S. Standard.

The 99th percentile values of temperature are in ° K and those of the wind components are in m/s. They are calculated from equation (3) with mean plus standard deviation having the appropriate units. The wind speed percentiles are calculated from (3) with mean and standard deviation as in (1) and (2) respectively.

Cross-sectional plots at 80° longitude are shown in Figures 1 - 12 for January and in Figures 13 - 24 for April. For July and October plots, reverse the signs on the latitude values of the January and April plots respectively. All plots are for 30 km to 90 km altitude and -90° to +90° latitude.

Cross-sectional plots at 45° latitude are shown for January (Figures 25 - 48), April (Figures 49 - 72), July (Figures 73 - 97) and October (Figures 97 - 120). The first 12 plots in each month group are for 0° to 180° W

longitude and the second 12 are for 180° to 360° W longitude. All plots are for 30 km to 90 km altitude.

The OFT re-entry trajectory provided by NASA is shown in Table 1. Trajectory plots are shown for 3 height ranges, 0 km to 30 km, 30 km to 90 km, and 90 km to 155 km. The 0 km to 30 km height range have plots for January (Figures 121 - 132) and July (Figures 175 - 186) while the 30 km to 90 km range has plots for January (Figures 133 - 144), April (Figures 163 - 174), July (Figures 187 - 198) and October (Figures 217 - 228). The wind plots were not generated for the 90 km to 155 km height range, but different levels of solar activity were used to generate January (Figures 145 - 162) and July (Figures 199 - 216) plots for this height range. Values used for the three levels of solar activity are as follows: (1) high solar activity - $F_{10.7} = 230$, $\bar{F}_{10.7} = 230$, $A_p = 400$, local time = 1400 at 155 km point, (2) average solar activity - $F_{10.7} = 150$, $\bar{F}_{10.7} = 150$, $A_p = 20.3$, local time = 0900 at 155 km point, (3) low solar activity $F_{10.7} = 68$, $\bar{F}_{10.7} = 68$, $A_p = 0$, local time = 0400 at 155 km point.

DISCUSSION OF RESULTS

The figures presented in this report can readily be used to determine which seasons would be best or worst for various types of re-entry orbits. For example, Figures 135, 165, 189, and 219 for the OFT orbit density in January, April, July and October show the largest density gradients in the 70 - 90 km altitude range to be in January (from +11 to -9 % U.S. Standard in about 50 seconds), while the best month is July (from -1 to + 7 % U.S. Standard in 50 seconds). Figures 3 and 15 show that for a polar orbit July would produce the strongest density gradients, while April and October would be best, and January would be only slightly better than July.

Table 1

OFT re-entry trajectory. Time is in seconds, height in kilometers, and latitude and West longitude in degrees. The first position shown was used as the zero - range position.

| TIME | HEIGHT | LAT. | W. LONG. | ZERO-RANGE REFERENCE POINT |
|--------|--------|-------|----------|----------------------------|
| 337.2 | 184.96 | 12.57 | 199.00 | |
| 3152.2 | 153.17 | 20.84 | 187.30 | |
| 3161.3 | 151.56 | 21.19 | 186.74 | |
| 3171.4 | 149.34 | 21.54 | 186.19 | |
| 3182.9 | 147.94 | 21.35 | 185.51 | |
| 3192.5 | 146.32 | 22.29 | 184.95 | |
| 3202.1 | 144.66 | 22.62 | 184.38 | |
| 3211.7 | 142.33 | 22.96 | 183.81 | |
| 3221.3 | 141.28 | 23.29 | 183.24 | |
| 3230.9 | 139.57 | 23.63 | 182.67 | |
| 3240.5 | 137.35 | 23.96 | 182.09 | |
| 3252.1 | 135.77 | 24.35 | 181.39 | |
| 3261.6 | 134.02 | 24.67 | 180.80 | |
| 3271.2 | 132.26 | 24.99 | 180.21 | |
| 3282.8 | 130.12 | 25.38 | 179.49 | |
| 3292.4 | 128.33 | 25.75 | 178.89 | |
| 3303.3 | 126.17 | 26.07 | 178.17 | |
| 3313.5 | 124.35 | 26.38 | 177.56 | |
| 3325.0 | 122.16 | 26.75 | 176.83 | |
| 3334.6 | 120.31 | 27.05 | 176.21 | |
| 3344.2 | 118.46 | 27.35 | 175.59 | |
| 3353.3 | 116.60 | 27.65 | 174.97 | |
| 3363.4 | 114.72 | 27.94 | 174.34 | |
| 3373.0 | 112.83 | 28.24 | 173.71 | |
| 3382.6 | 110.94 | 28.52 | 173.74 | |
| 3392.2 | 109.03 | 28.81 | 172.43 | |
| 3401.8 | 107.12 | 29.09 | 171.79 | |
| 3411.4 | 105.13 | 29.37 | 171.14 | |
| 3421.0 | 103.26 | 29.65 | 170.49 | |
| 3430.6 | 101.32 | 29.92 | 169.83 | |
| 3440.2 | 99.37 | 30.19 | 169.17 | |
| 3451.7 | 97.02 | 30.50 | 168.33 | |
| 3461.3 | 95.06 | 30.77 | 167.71 | |
| 3470.9 | 93.10 | 31.02 | 167.03 | |
| 3482.4 | 90.76 | 31.32 | 166.22 | |
| 3492.0 | 88.81 | 31.60 | 165.54 | |
| 3501.6 | 86.88 | 31.82 | 164.85 | |
| 3511.2 | 84.93 | 32.06 | 164.16 | |
| 3520.8 | 83.12 | 32.29 | 163.46 | |
| 3530.4 | 81.34 | 32.52 | 162.77 | |
| 3540.0 | 79.64 | 32.75 | 162.07 | |
| 3549.6 | 78.06 | 32.97 | 161.36 | |
| 3559.2 | 76.59 | 33.19 | 160.66 | |
| 3568.9 | 75.36 | 33.40 | 159.96 | |
| 3578.4 | 74.34 | 33.60 | 159.25 | |
| 3588.0 | 73.52 | 33.80 | 158.55 | |
| 3597.6 | 72.35 | 33.99 | 157.82 | |
| 3607.2 | 72.31 | 34.18 | 157.11 | |
| 3616.8 | 71.37 | 34.35 | 156.40 | |
| 3626.4 | 71.52 | 34.51 | 155.69 | |
| 3636.0 | 71.24 | 34.67 | 154.97 | |
| 3645.6 | 71.00 | 34.82 | 154.26 | |
| 3655.2 | 70.42 | 34.95 | 153.55 | |
| 3664.8 | 70.66 | 35.08 | 152.84 | |
| 3674.4 | 70.47 | 35.20 | 152.13 | |
| 3684.0 | 70.26 | 35.31 | 151.42 | |
| 3693.6 | 70.04 | 35.41 | 150.71 | |
| 3703.2 | 69.79 | 35.49 | 150.01 | |
| 3712.8 | 69.52 | 35.57 | 149.31 | |
| 3722.4 | 69.21 | 35.64 | 148.61 | |

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Table 1 Cont.

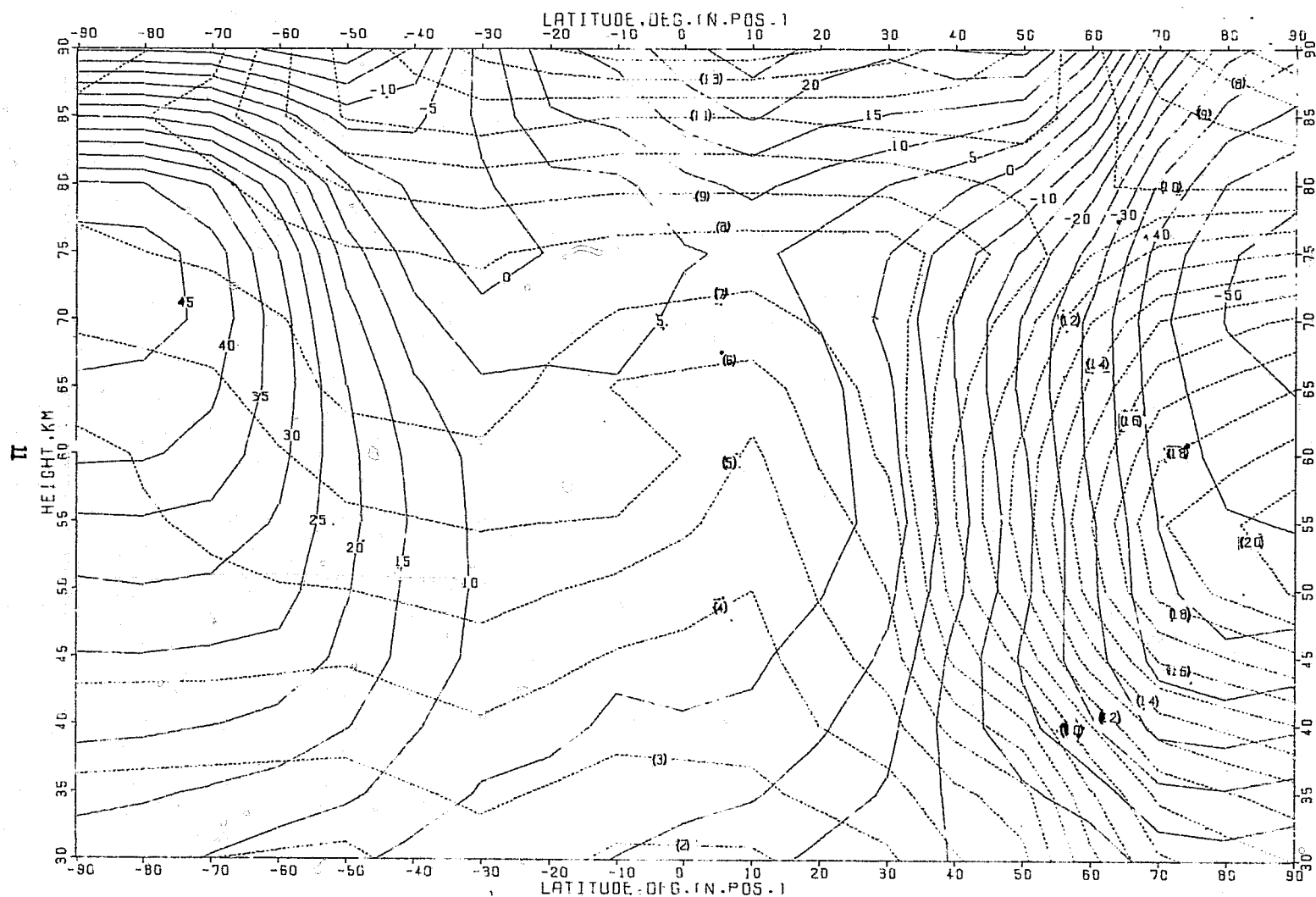
| TIME | HEIGHT | LAT. | W. LONG. |
|--------|--------|-------|----------|
| 3732.0 | 68.88 | 35.71 | 147.92 |
| 3741.6 | 68.54 | 35.76 | 147.23 |
| 3751.2 | 68.19 | 35.80 | 146.55 |
| 3760.8 | 67.83 | 35.83 | 145.87 |
| 3770.4 | 67.45 | 35.85 | 145.19 |
| 3780.0 | 67.08 | 35.87 | 144.53 |
| 3789.6 | 66.70 | 35.87 | 143.86 |
| 3799.2 | 66.33 | 35.86 | 143.21 |
| 3808.8 | 65.94 | 35.85 | 142.56 |
| 3818.4 | 65.55 | 35.83 | 141.92 |
| 3828.0 | 65.14 | 35.79 | 141.29 |
| 3837.6 | 64.73 | 35.75 | 140.66 |
| 3847.2 | 64.30 | 35.70 | 140.04 |
| 3856.8 | 63.88 | 35.74 | 139.44 |
| 3866.4 | 63.46 | 35.57 | 138.84 |
| 3876.0 | 63.05 | 35.49 | 138.26 |
| 3885.6 | 62.64 | 35.40 | 137.69 |
| 3895.2 | 62.25 | 35.31 | 137.12 |
| 3904.8 | 61.87 | 35.21 | 136.56 |
| 3914.4 | 61.64 | 35.10 | 136.02 |
| 3924.0 | 61.75 | 34.98 | 135.49 |
| 3933.6 | 62.02 | 34.89 | 134.97 |
| 3943.2 | 61.96 | 34.77 | 134.46 |
| 3952.8 | 61.45 | 34.68 | 133.95 |
| 3962.4 | 60.74 | 34.58 | 133.45 |
| 3972.0 | 59.99 | 34.50 | 132.95 |
| 3981.6 | 59.33 | 34.42 | 132.47 |
| 3991.2 | 58.91 | 34.34 | 131.99 |
| 4000.8 | 58.42 | 34.27 | 131.52 |
| 4010.4 | 58.11 | 34.20 | 131.06 |
| 4020.0 | 57.92 | 34.14 | 130.61 |
| 4029.6 | 57.54 | 34.09 | 130.17 |
| 4039.2 | 57.24 | 34.04 | 129.74 |
| 4048.8 | 56.92 | 34.00 | 129.31 |
| 4058.4 | 56.57 | 33.96 | 128.90 |
| 4068.0 | 56.13 | 33.93 | 128.49 |
| 4077.6 | 55.78 | 33.90 | 128.09 |
| 4087.2 | 55.30 | 33.88 | 127.62 |
| 4096.8 | 54.89 | 33.86 | 127.24 |
| 4106.4 | 54.47 | 33.85 | 126.87 |
| 4116.0 | 54.03 | 33.85 | 126.51 |
| 4125.6 | 53.63 | 33.85 | 126.23 |
| 4135.2 | 53.07 | 33.85 | 125.88 |
| 4144.8 | 52.40 | 33.86 | 125.54 |
| 4154.4 | 51.65 | 33.87 | 125.22 |
| 4164.0 | 50.80 | 33.89 | 124.90 |
| 4173.6 | 49.91 | 33.92 | 124.59 |
| 4183.2 | 49.09 | 33.95 | 124.28 |
| 4192.8 | 48.30 | 33.99 | 123.99 |
| 4202.4 | 47.54 | 34.02 | 123.71 |
| 4212.0 | 46.78 | 34.06 | 123.44 |
| 4221.6 | 46.03 | 34.11 | 123.17 |
| 4231.2 | 45.26 | 34.15 | 122.92 |
| 4240.8 | 44.50 | 34.21 | 122.67 |
| 4250.4 | 43.74 | 34.27 | 122.44 |
| 4260.0 | 42.97 | 34.34 | 122.21 |
| 4269.6 | 42.26 | 34.41 | 122.00 |
| 4279.2 | 41.79 | 34.48 | 121.79 |
| 4288.8 | 41.07 | 34.56 | 121.59 |
| 4298.4 | 40.40 | 34.64 | 121.41 |

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Table 1 Cont.

| TIME | HEIGHT | LAT. | W. LONG. |
|--------|--------|-------|----------|
| 4333.0 | 39.74 | 34.72 | 121.23 |
| 4317.6 | 39.44 | 34.80 | 121.06 |
| 4327.2 | 38.93 | 34.97 | 120.89 |
| 4336.8 | 38.12 | 34.92 | 120.72 |
| 4345.4 | 37.13 | 34.97 | 120.56 |
| 4356.0 | 36.22 | 35.01 | 120.40 |
| 4365.6 | 35.34 | 35.05 | 120.24 |
| 4375.2 | 34.46 | 35.07 | 120.08 |
| 4384.8 | 33.64 | 35.03 | 119.94 |
| 4394.4 | 32.27 | 35.03 | 119.79 |
| 4402.1 | 32.23 | 35.03 | 119.68 |
| 4411.7 | 31.58 | 35.09 | 119.55 |
| 4421.3 | 30.83 | 35.03 | 119.43 |
| 4430.9 | 30.12 | 35.06 | 119.31 |
| 4440.5 | 29.28 | 35.04 | 119.20 |
| 4450.1 | 28.51 | 35.01 | 119.10 |
| 4459.7 | 27.84 | 34.99 | 119.00 |
| 4469.3 | 27.35 | 34.97 | 118.91 |
| 4478.9 | 26.56 | 34.96 | 118.82 |
| 4488.2 | 24.44 | 34.96 | 118.67 |
| 4507.7 | 23.59 | 34.96 | 118.58 |
| 4515.4 | 23.07 | 34.97 | 118.52 |
| 4524.0 | 22.44 | 34.97 | 118.46 |
| 4534.6 | 21.55 | 34.98 | 118.39 |
| 4544.2 | 20.62 | 34.98 | 118.34 |
| 4554.8 | 19.51 | 34.93 | 118.29 |
| 4564.4 | 18.47 | 35.00 | 118.23 |
| 4574.0 | 17.42 | 35.00 | 118.19 |
| 4583.6 | 16.40 | 35.01 | 118.15 |
| 4594.1 | 15.32 | 35.02 | 118.11 |
| 4604.7 | 14.30 | 35.02 | 118.08 |
| 4614.3 | 13.42 | 35.03 | 118.05 |
| 4624.9 | 12.43 | 35.03 | 118.02 |
| 4633.5 | 11.72 | 35.03 | 117.99 |
| 4643.1 | 10.90 | 35.04 | 117.97 |
| 4653.6 | 10.02 | 35.04 | 117.94 |
| 4663.2 | 9.24 | 35.05 | 117.92 |
| 4673.8 | 8.39 | 35.05 | 117.90 |
| 4683.4 | 7.55 | 35.05 | 117.88 |
| 4693.0 | 6.82 | 35.04 | 117.86 |
| 4703.6 | 5.00 | 35.03 | 117.84 |
| 4713.2 | 5.26 | 35.02 | 117.83 |
| 4723.7 | 4.44 | 35.00 | 117.82 |
| 4733.0 | 3.74 | 34.99 | 117.83 |
| 4743.2 | 2.95 | 34.97 | 117.83 |
| 4745.3 | 2.79 | 34.97 | 117.83 |
| 4755.2 | 2.07 | 34.95 | 117.83 |
| 4765.2 | 1.37 | 34.94 | 117.84 |
| 4775.4 | .89 | 34.93 | 117.84 |
| 4784.8 | .19 | 34.91 | 117.84 |

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KEY -

——— PRESSURE, PER CENT DEV. FROM STD. ATM.

----- STD. DEV. OF PRESSURE

DURING MONTH OF JANUARY

AT A LONGITUDE OF 80 DEGREES

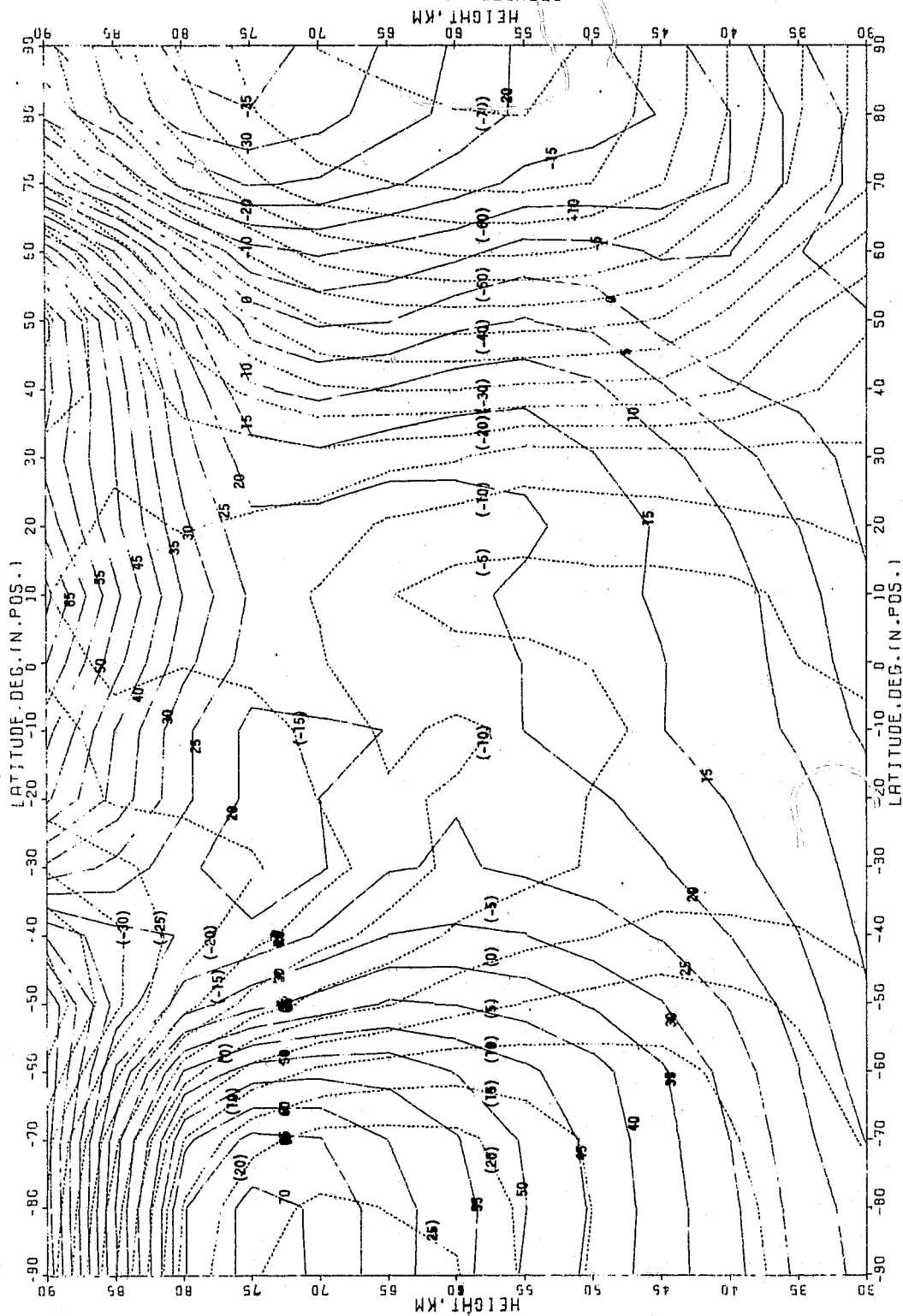
44, 14013H

FIG 1

KEY

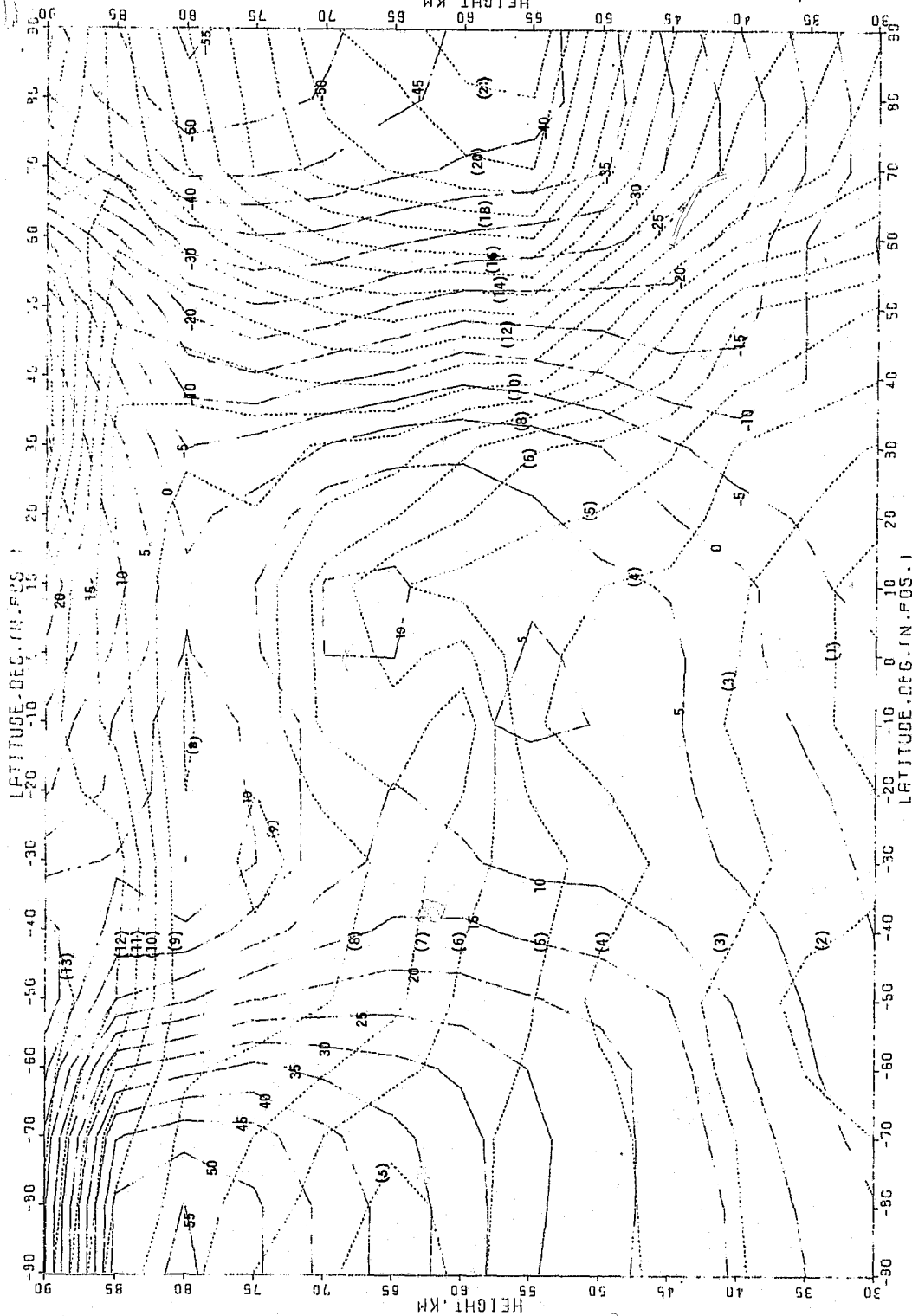
FIG 2

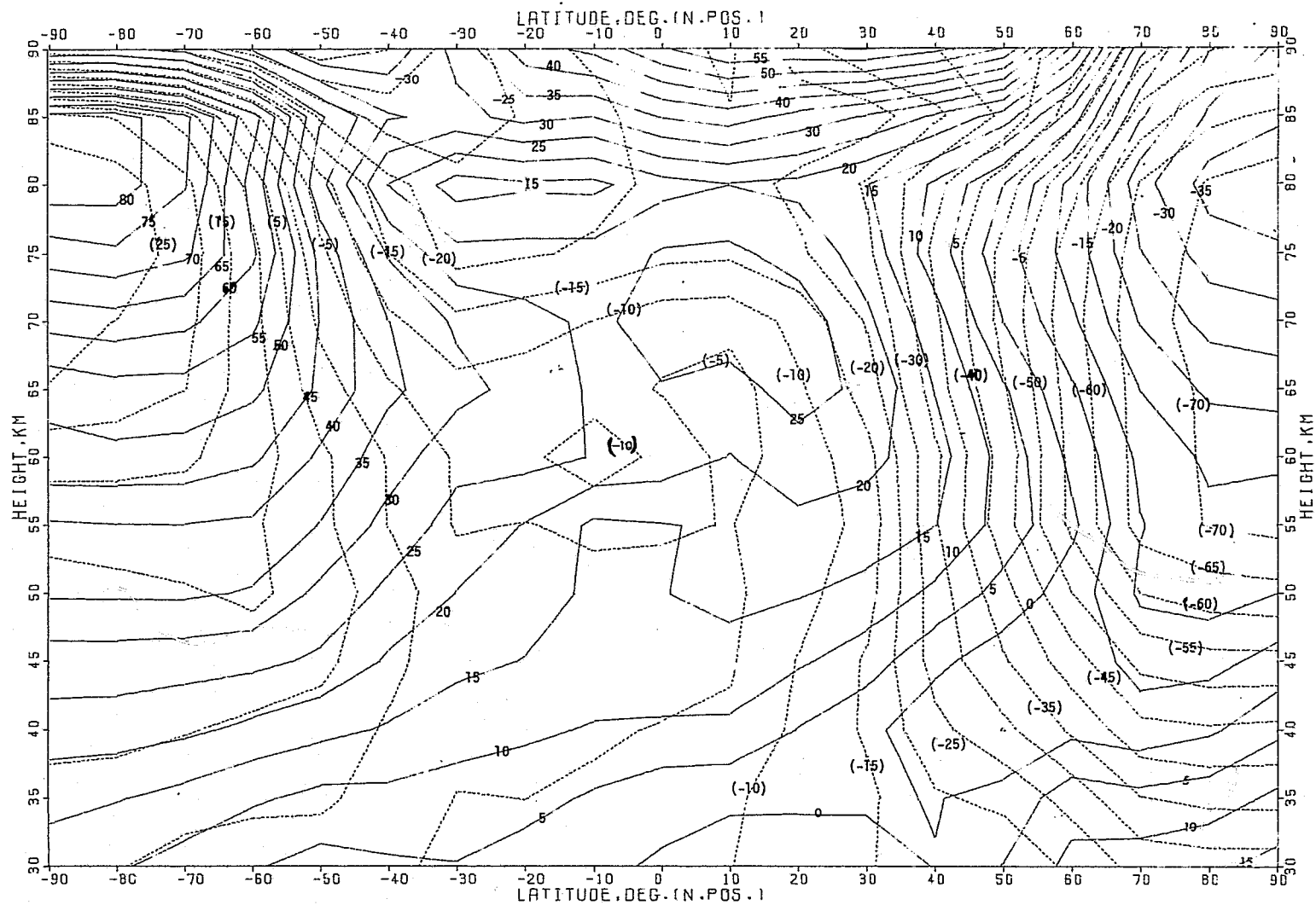
—— UPPER 99TH PERCENTILE OF PRESSURE
 LOWER 99TH PERCENTILE OF PRESSURE
 DURING MONTH OF JANUARY
 AT A LONGITUDE OF 80 DEGREES



KEY-

HEIGHT, KM



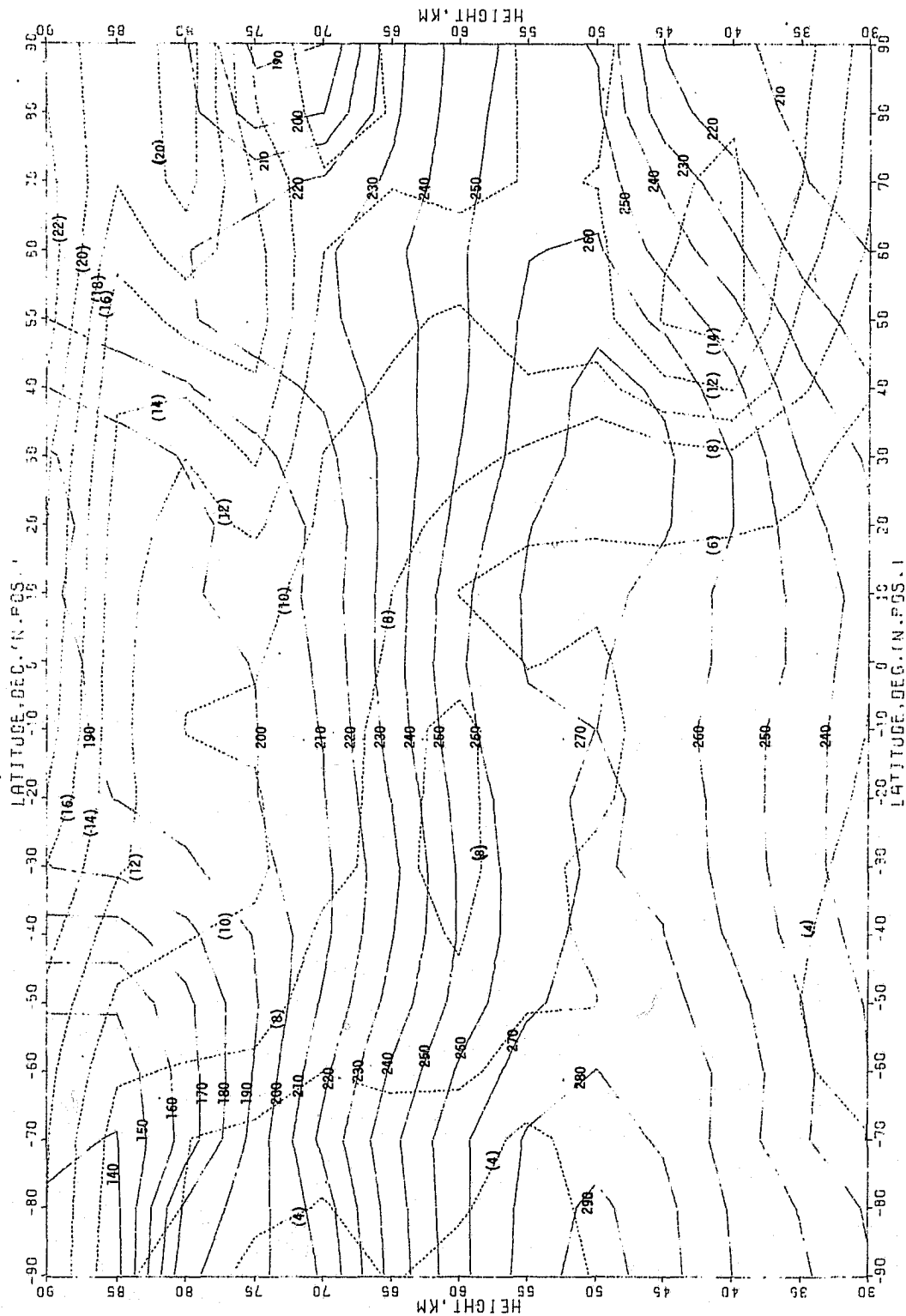


KEY -

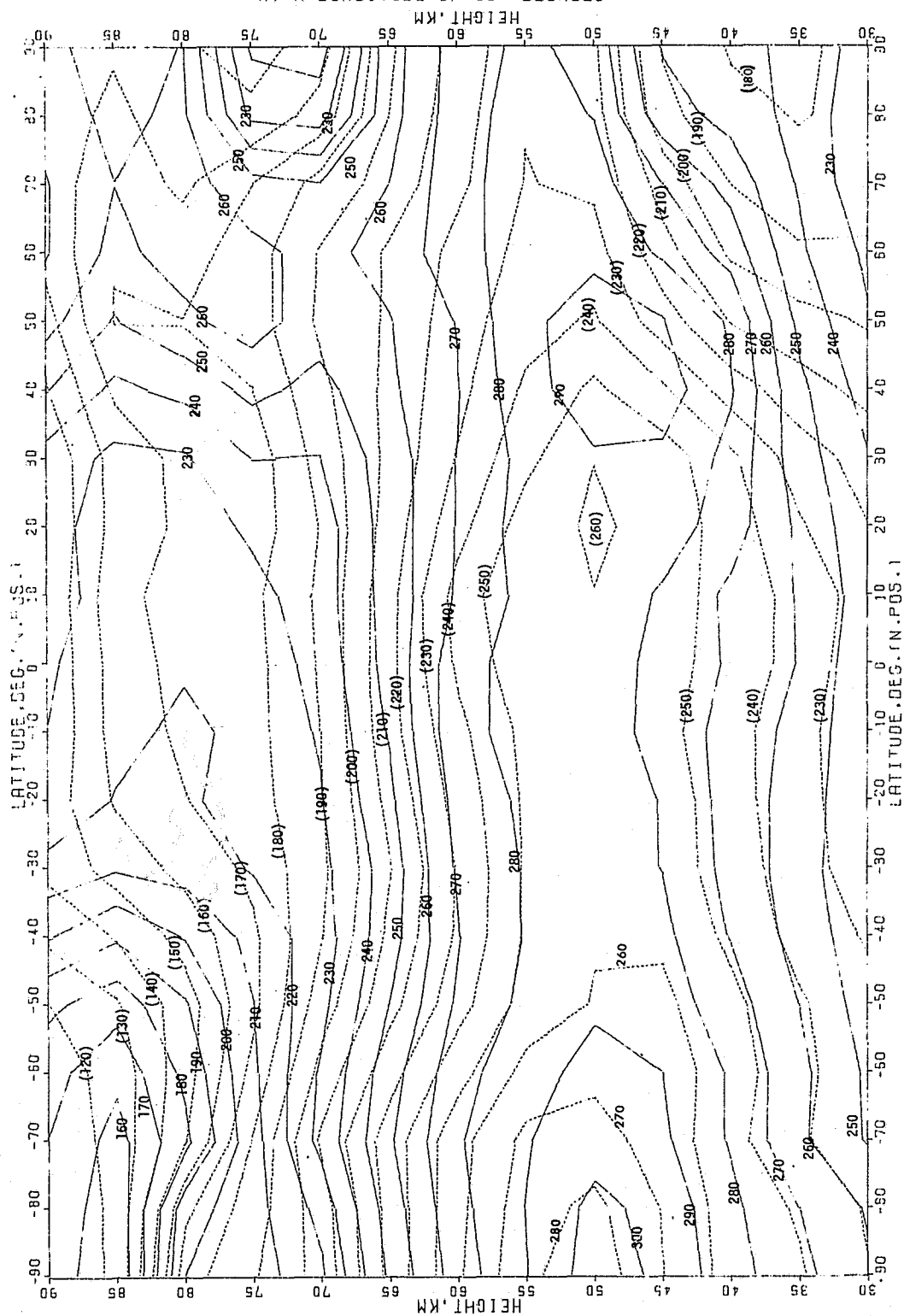
FIG 4

—— UPPER 99TH PERCENTILE OF DENSITY
 - - - - LOWER 99TH PERCENTILE OF DENSITY
 DURING MONTH OF JANUARY
 AT A LONGITUDE OF 80 DEGREES

KEY-
 ——— TEMPERATURE, DEG. K
 - - - - - STD. DEV. OF TEMPERATURE
 DURING MONTH OF JANUARY
 AT A LONGITUDE OF 80 DEGREES

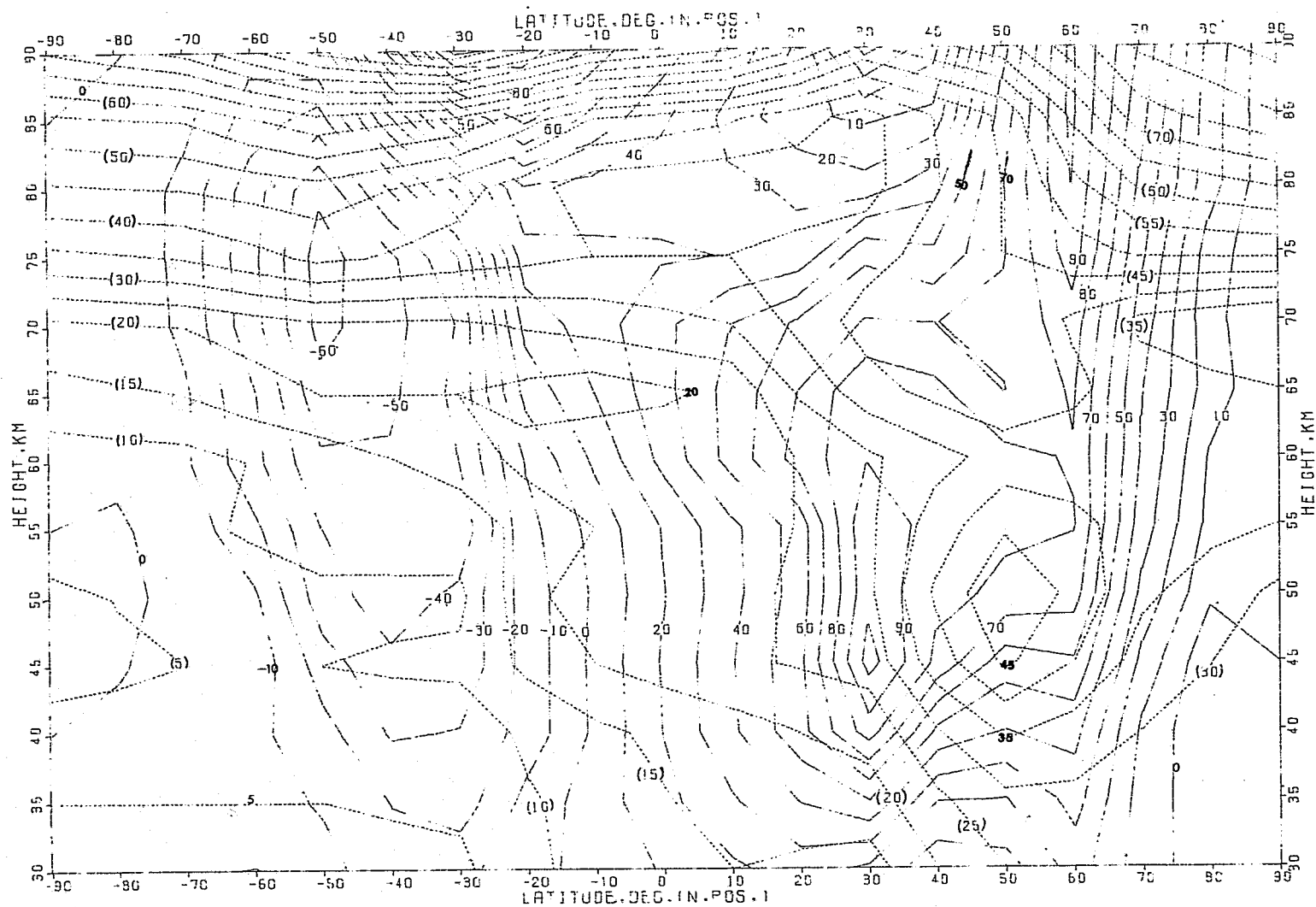


KEY-
 ——— UPPER 99TH PERCENTILE OF TEMPERATURE
 - - - - - LOWER 99TH PERCENTILE OF TEMPERATURE
 DURING MONTH OF JANUARY
 AT A LONGITUDE OF 80 DEGREES



KEY-
 — EASTWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 STD. DEV. OF EASTWARD WIND
 DURING MONTH OF JANUARY
 AT A LONGITUDE OF 80 DEGREES

FIG 7



KEY-

FIG 8

—— UPPER 99TH PERCENTILE OF EASTWARD WIND
 - - - - - LOWER 99TH PERCENTILE OF EASTWARD WIND
 DURING MONTH OF JANUARY
 AT A LONGITUDE OF 80 DEGREES

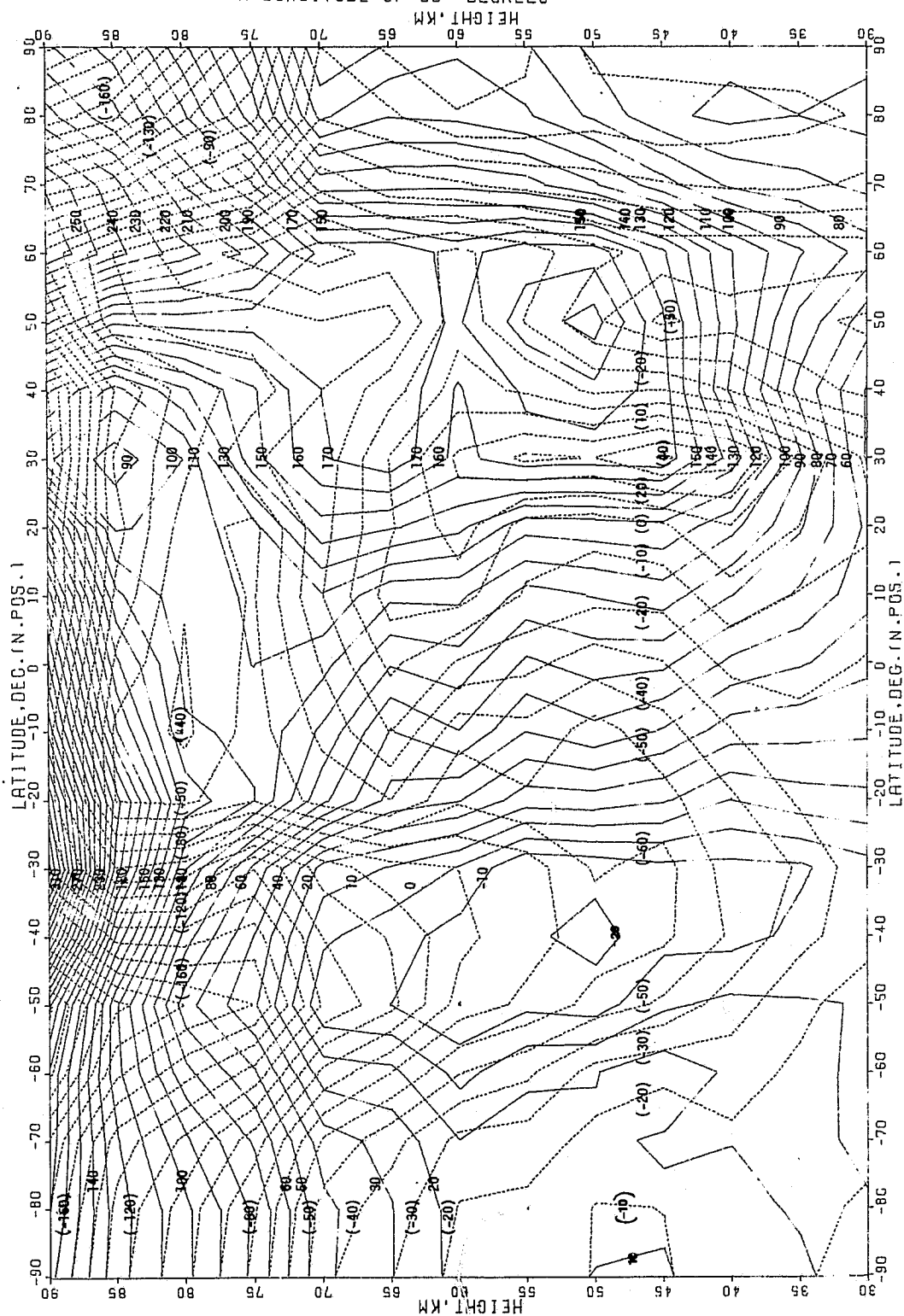
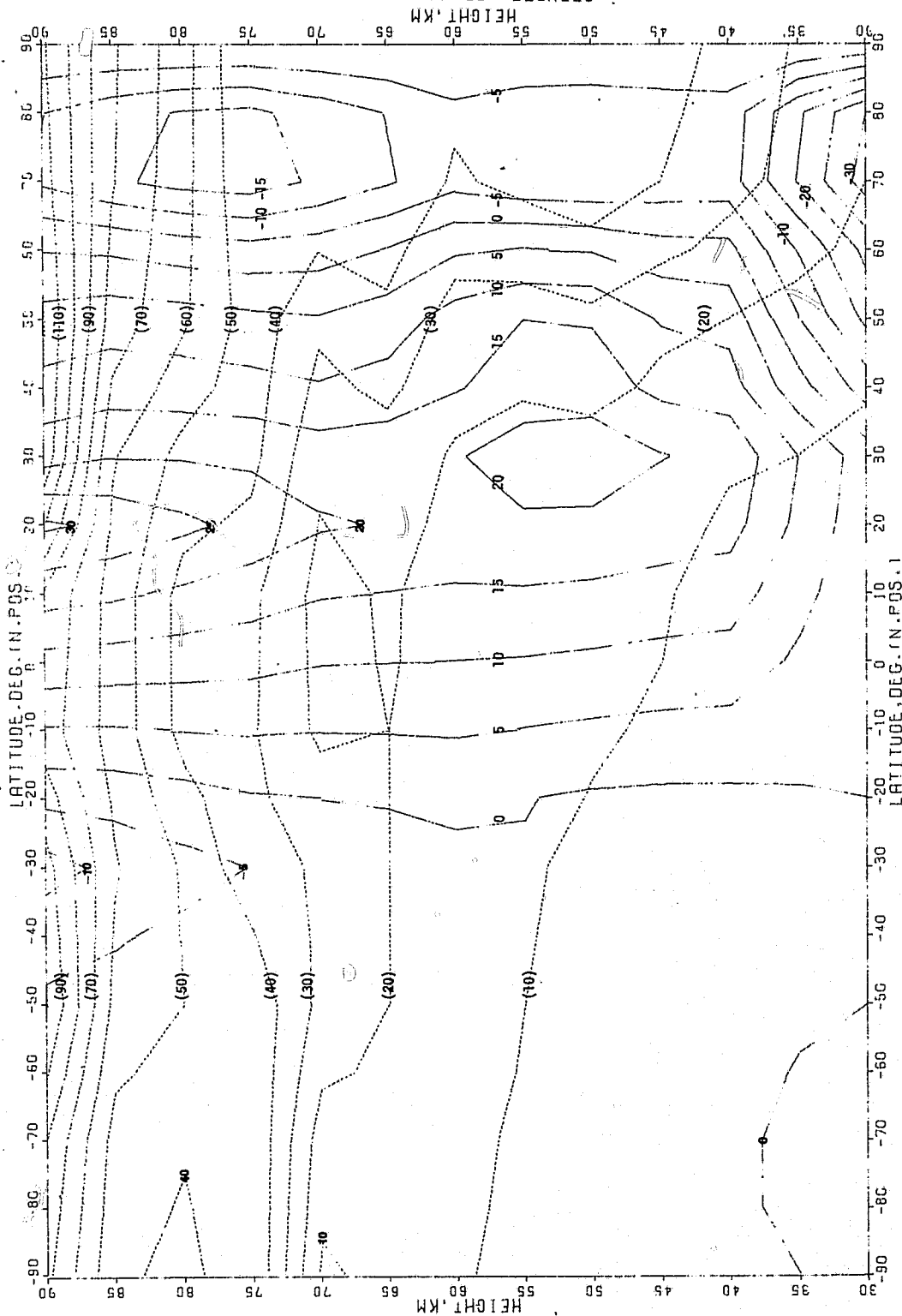


FIG 9

KEY-

— NORTHWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - STD. DEV. OF NORTHWARD WIND
 DURING MONTH OF JANUARY
 AT A LONGITUDE OF 80 DEGREES

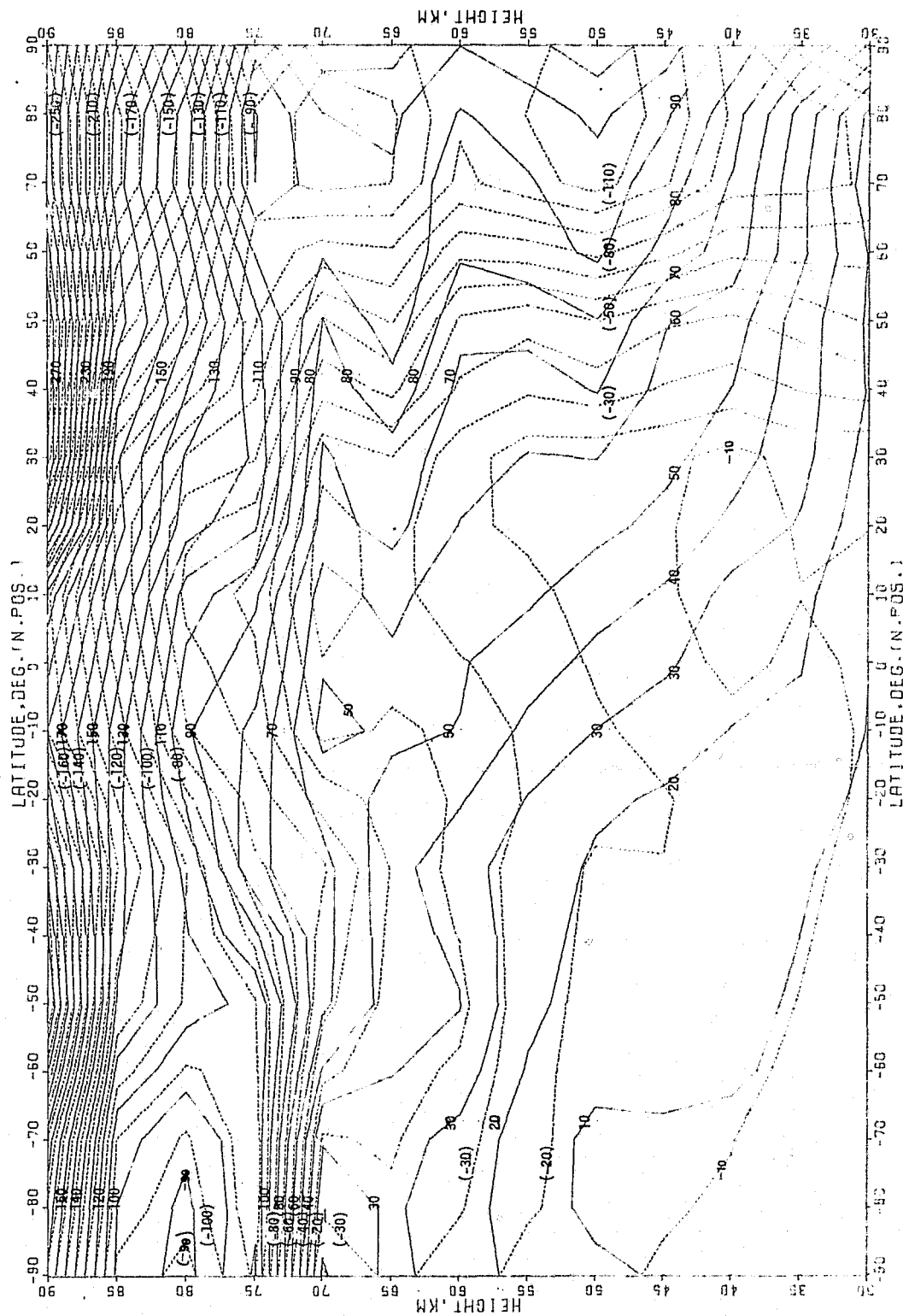


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KEY-

FIG 10

----- UPPER 99TH PERCENTILE OF NORTHWARD WIND
 ----- LOWER 99TH PERCENTILE OF NORTHWARD WIND
 DURING MONTH OF JANUARY
 AT A LONGITUDE OF 80 DEGREES



KEY-
 — WIND SPEED M/S
 - - - STD. DEV. OF WIND SPEED
 DURING MONTH OF JANUARY
 AT A LONGITUDE OF 80 DEGREES

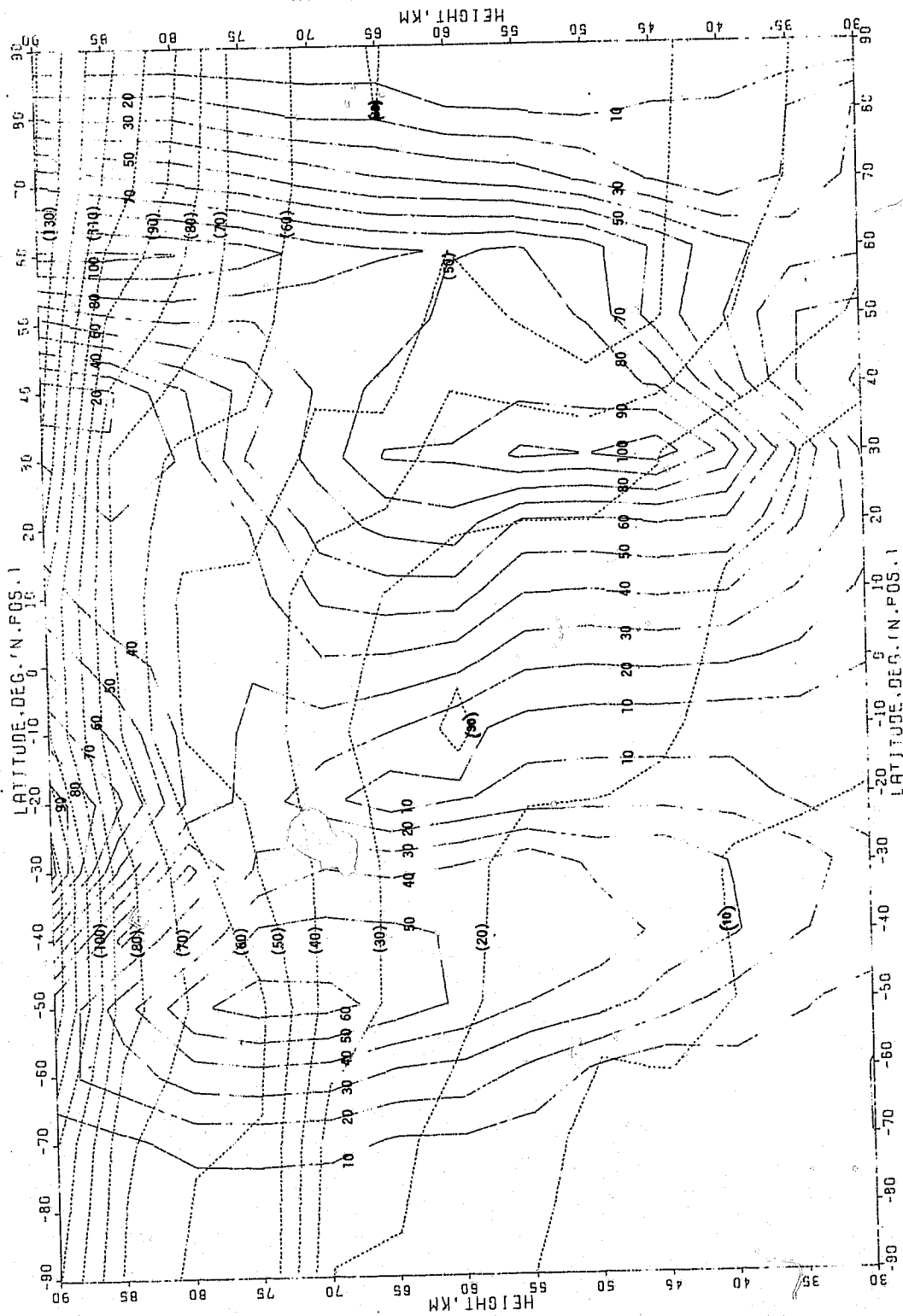
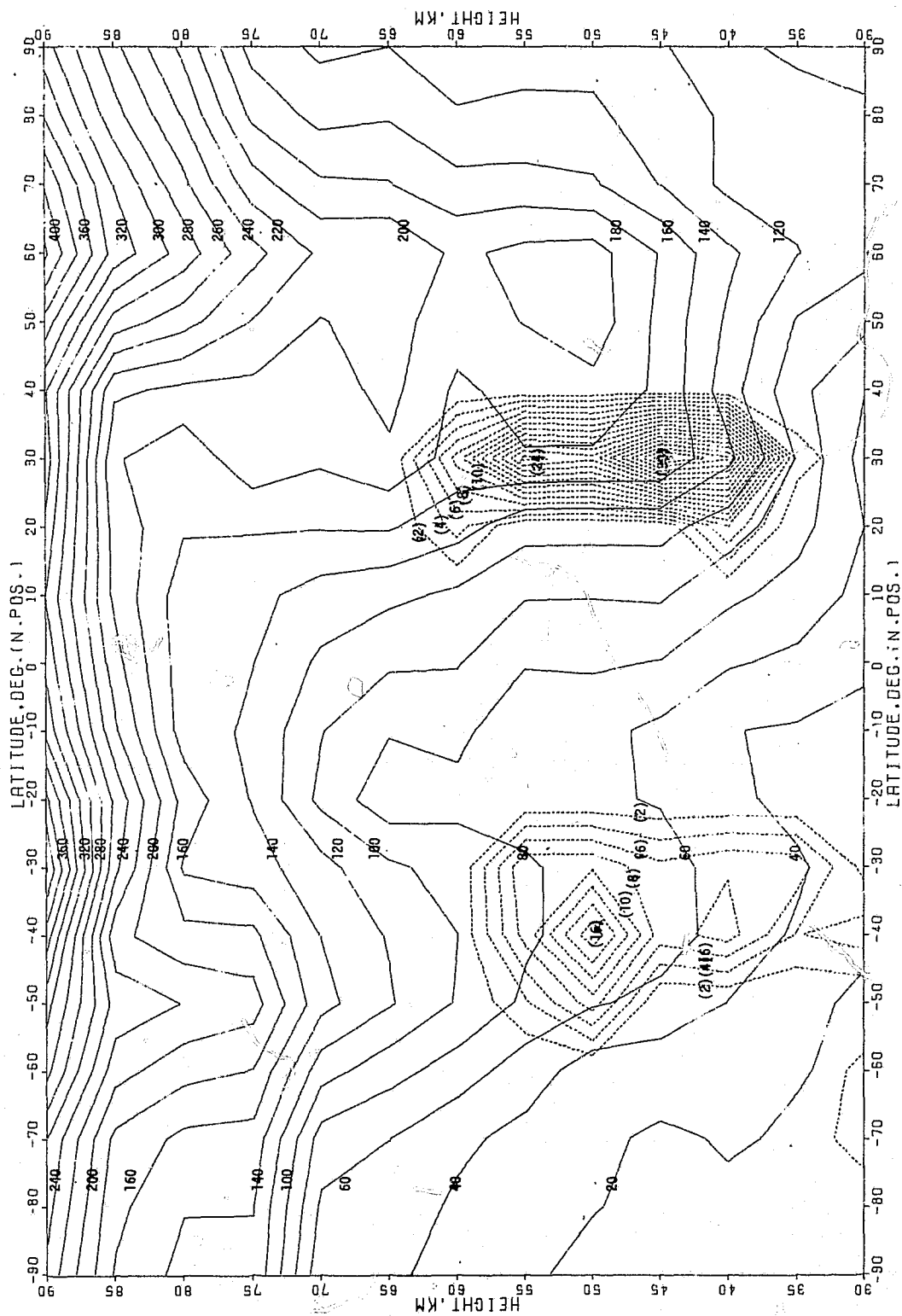


FIG 12

KEY-

—— UPPER 99TH PERCENTILE OF SPEED
 - - - - - LOWER 99TH PERCENTILE OF SPEED
 DURING MONTH OF JANUARY
 AT A LONGITUDE OF 80 DEGREES



KEY-

FIG 13

——— PRESSURE, PER CENT DEV. FROM STD. ATM.
 (---) STD. DEV. OF PRESSURE
 DURING MONTH OF APRIL
 AT A LONGITUDE OF 80 DEGREES

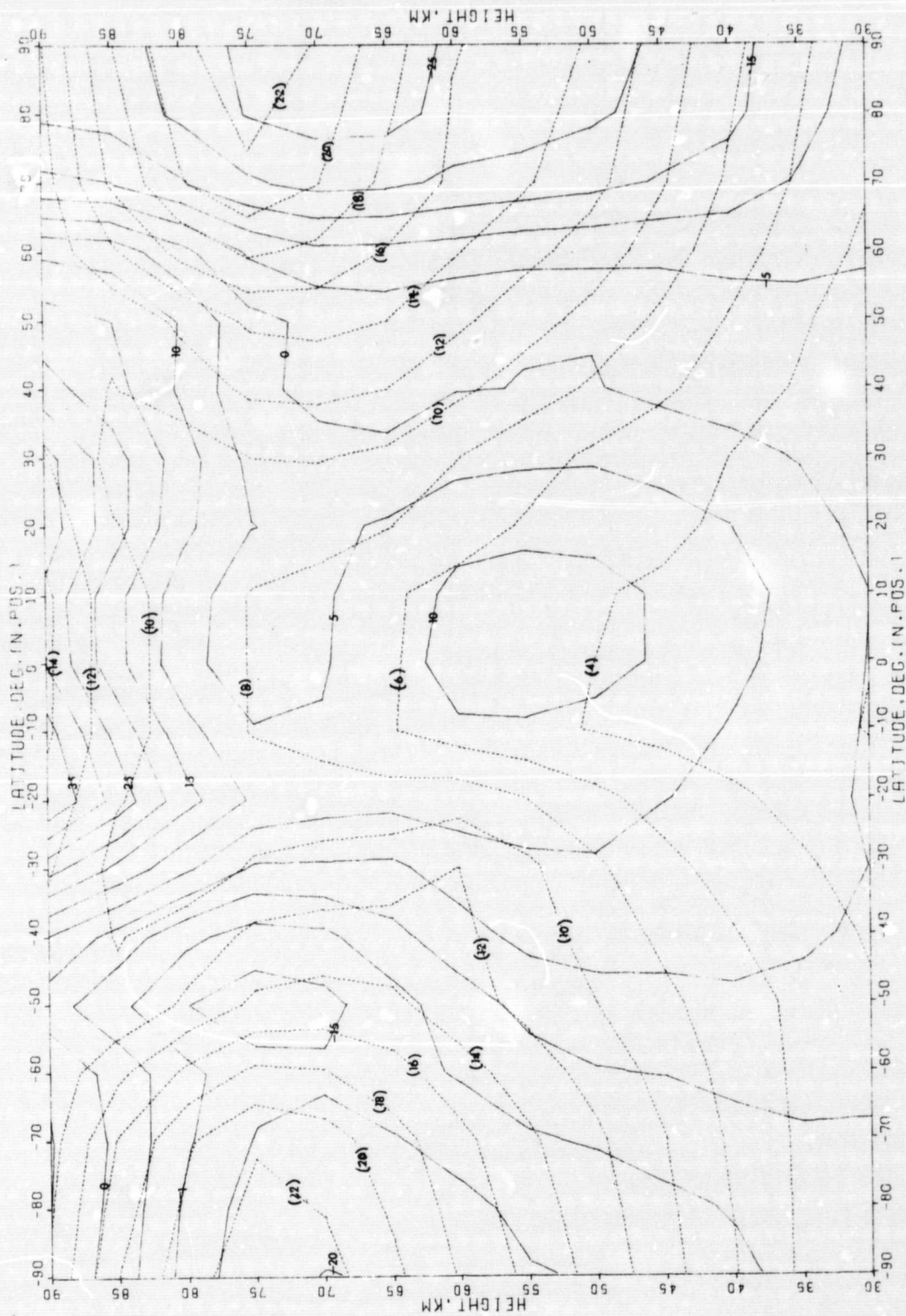
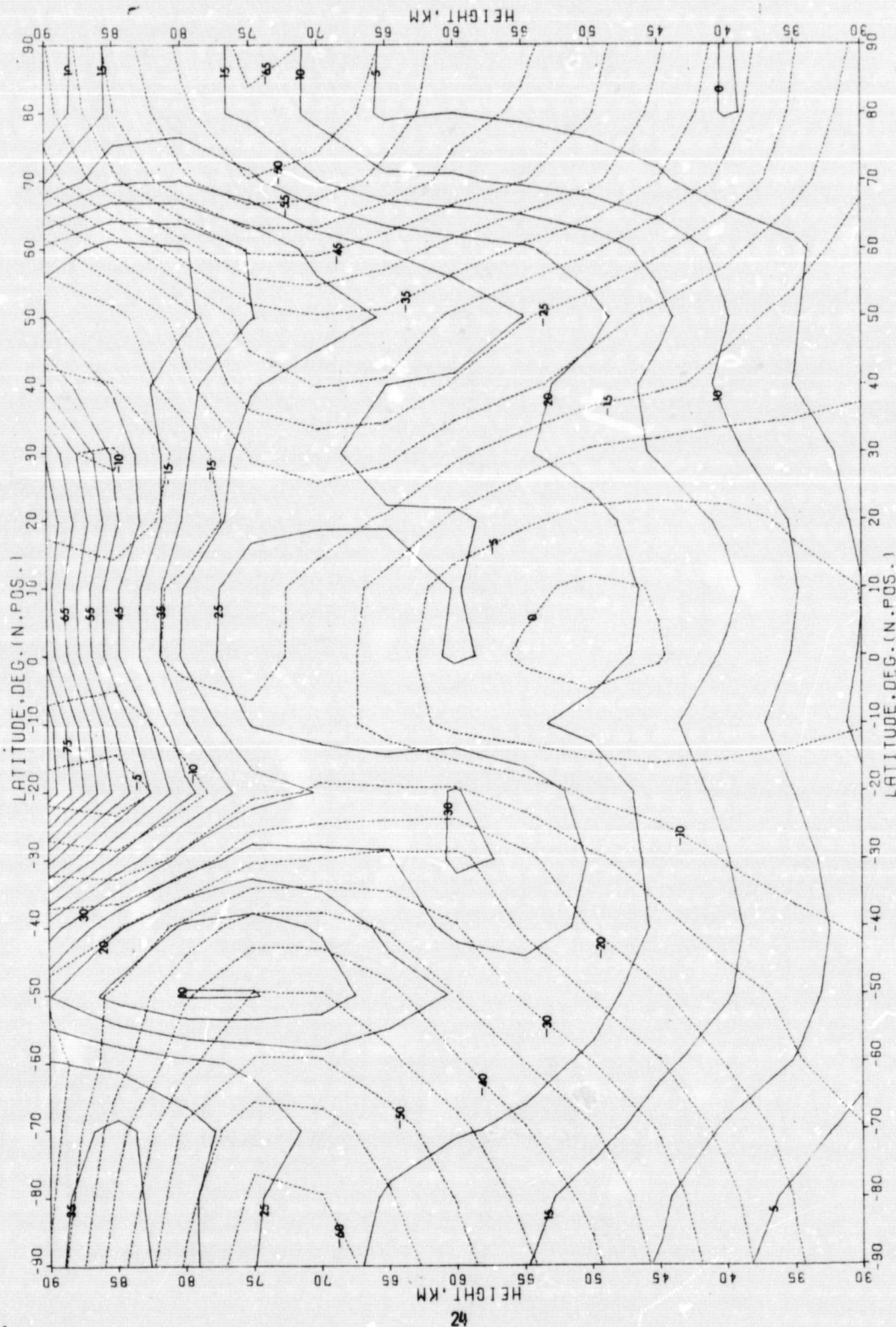


FIG 14

KEY -

—— UPPER 99TH PERCENTILE OF PRESSURE
 (---) LOWER 99TH PERCENTILE OF PRESSURE
 DURING MONTH OF APRIL
 AT A LONGITUDE OF 80 DEGREES



KEY -

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FIG 16

— UPPER 99TH PERCENTILE OF DENSITY
 (---) LOWER 99TH PERCENTILE OF DENSITY
 DURING MONTH OF APRIL
 AT A LONGITUDE OF 80 DEGREES

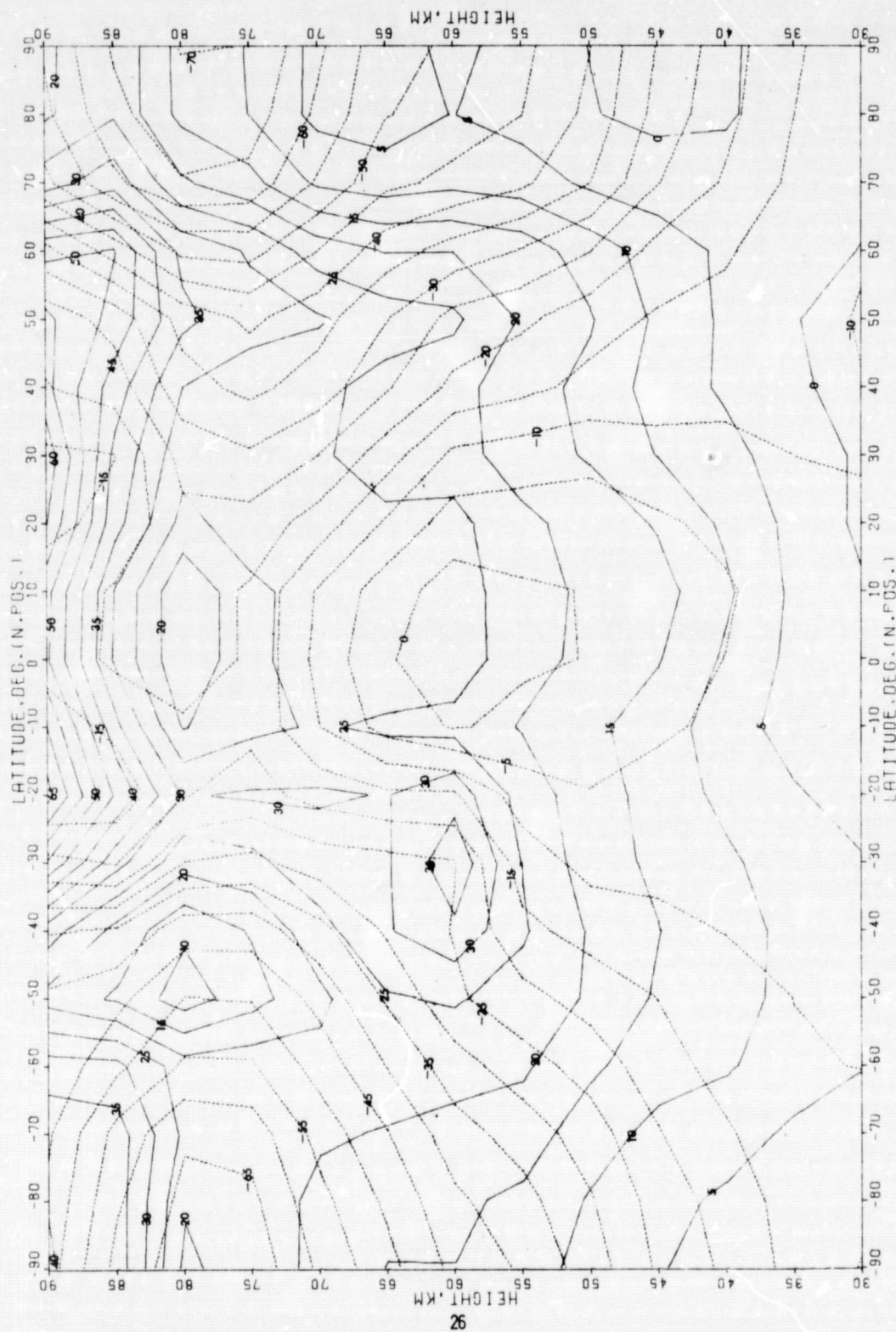


FIG 17

KEY -

—— TEMPERATURE, DEG. K
 |---| STD. DEV. OF TEMPERATURE|
 DURING MONTH OF APRIL
 AT A LONGITUDE OF 80 DEGREES

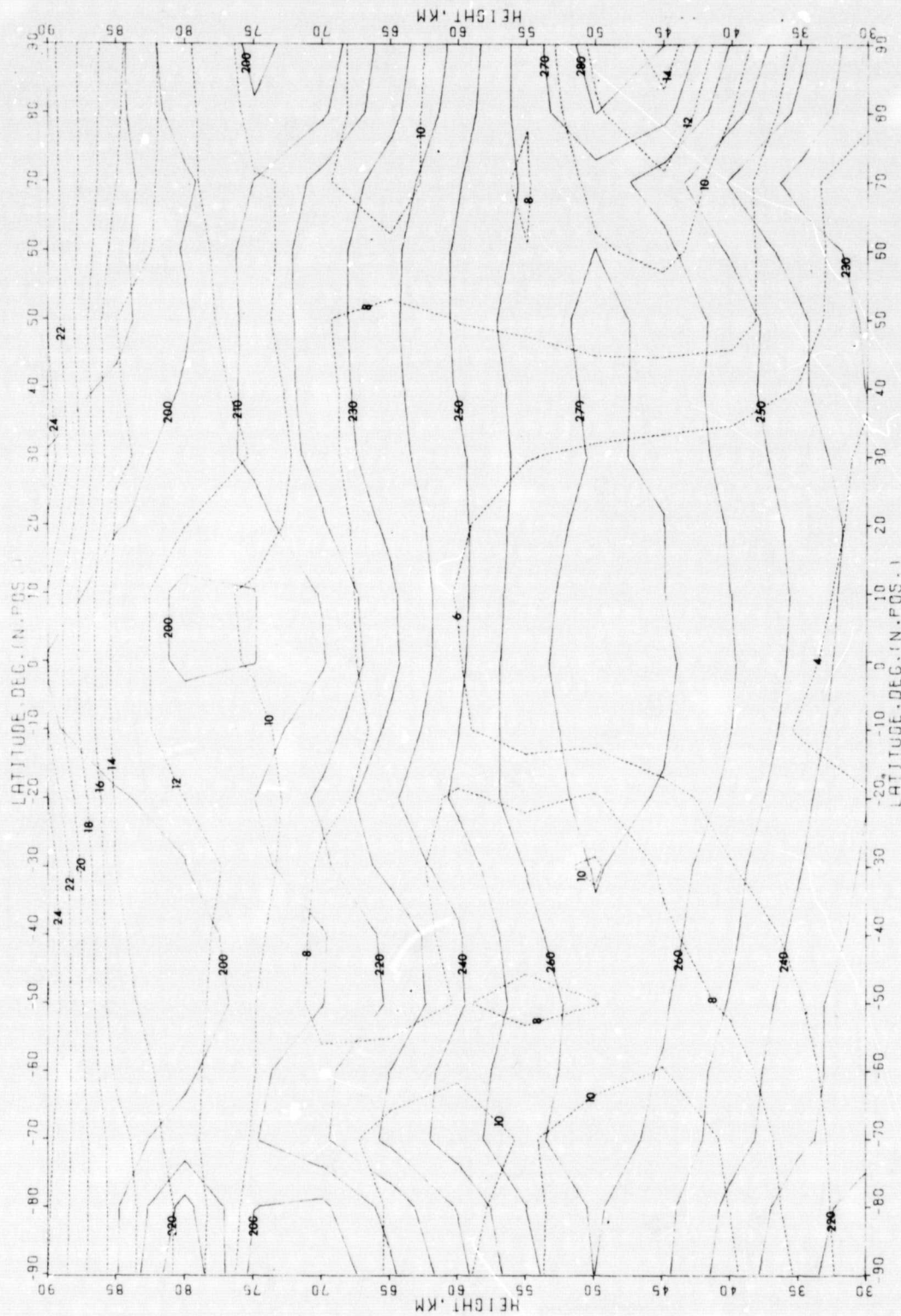


FIG 18

KEY-

—— UPPER 99TH PERCENTILE OF TEMPERATURE
 LOWER 99TH PERCENTILE OF TEMPERATURE
 DURING MONTH OF APRIL
 AT A LONGITUDE OF 80 DEGREES

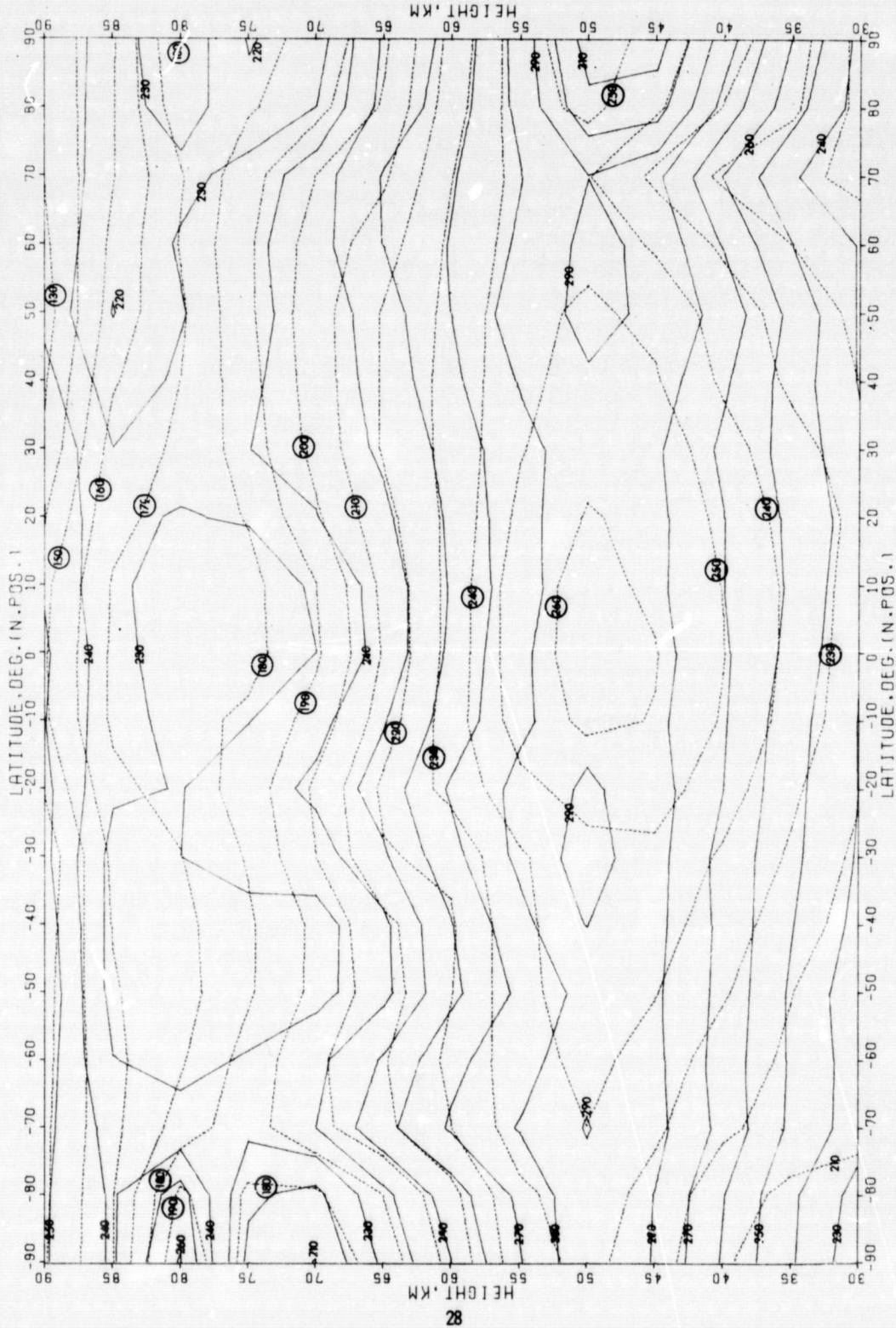


FIG 19

KEY-

—— EASTWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - - - STD. DEV. OF EASTWARD WIND
 DURING MONTH OF APRIL
 AT A LONGITUDE OF 80 DEGREES

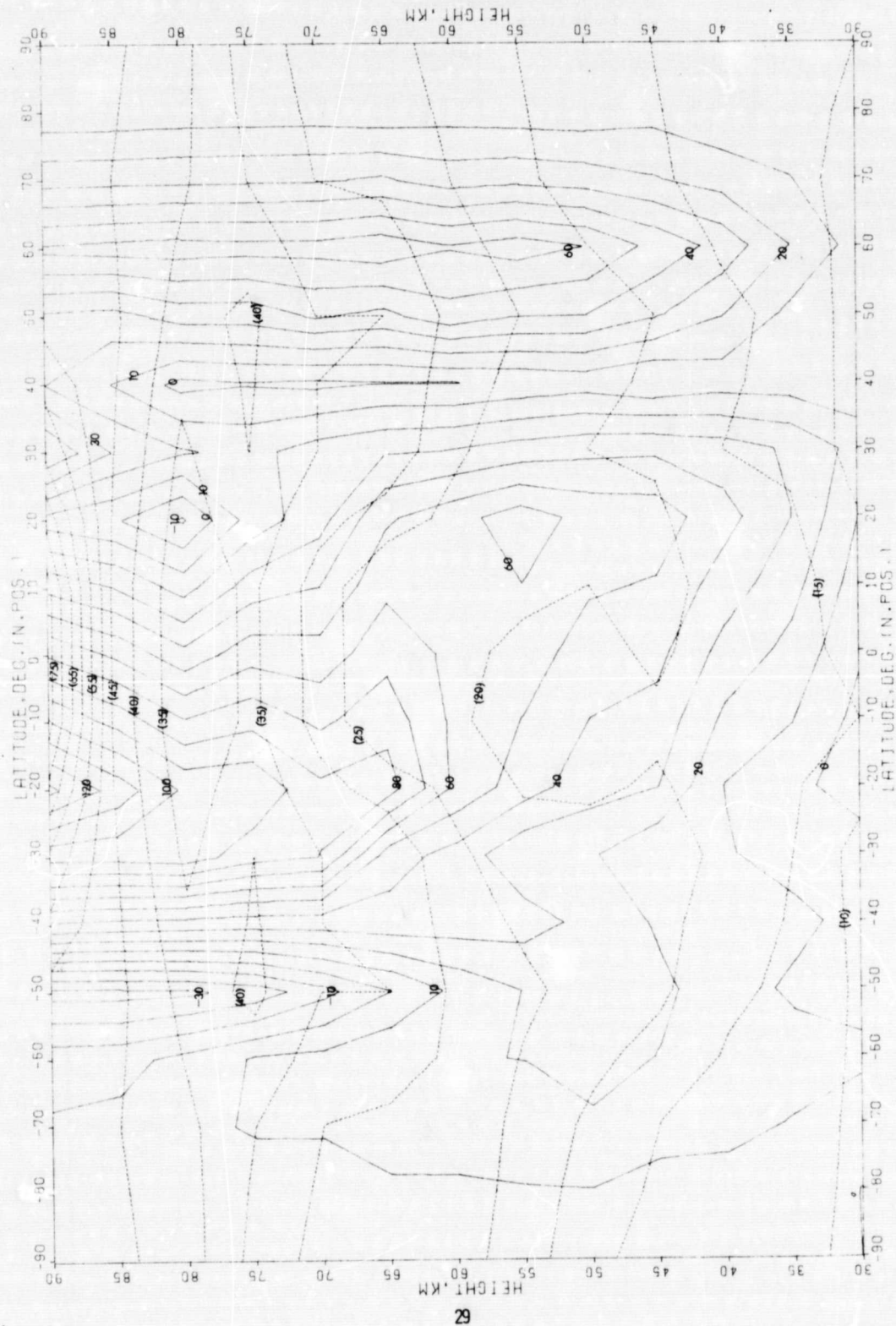


FIG 20

KEY -

—— UPPER 99TH PERCENTILE OF EASTWARD WIND
 LOWER 99TH PERCENTILE OF EASTWARD WIND
 DURING MONTH OF APRIL
 AT A LONGITUDE OF 80 DEGREES

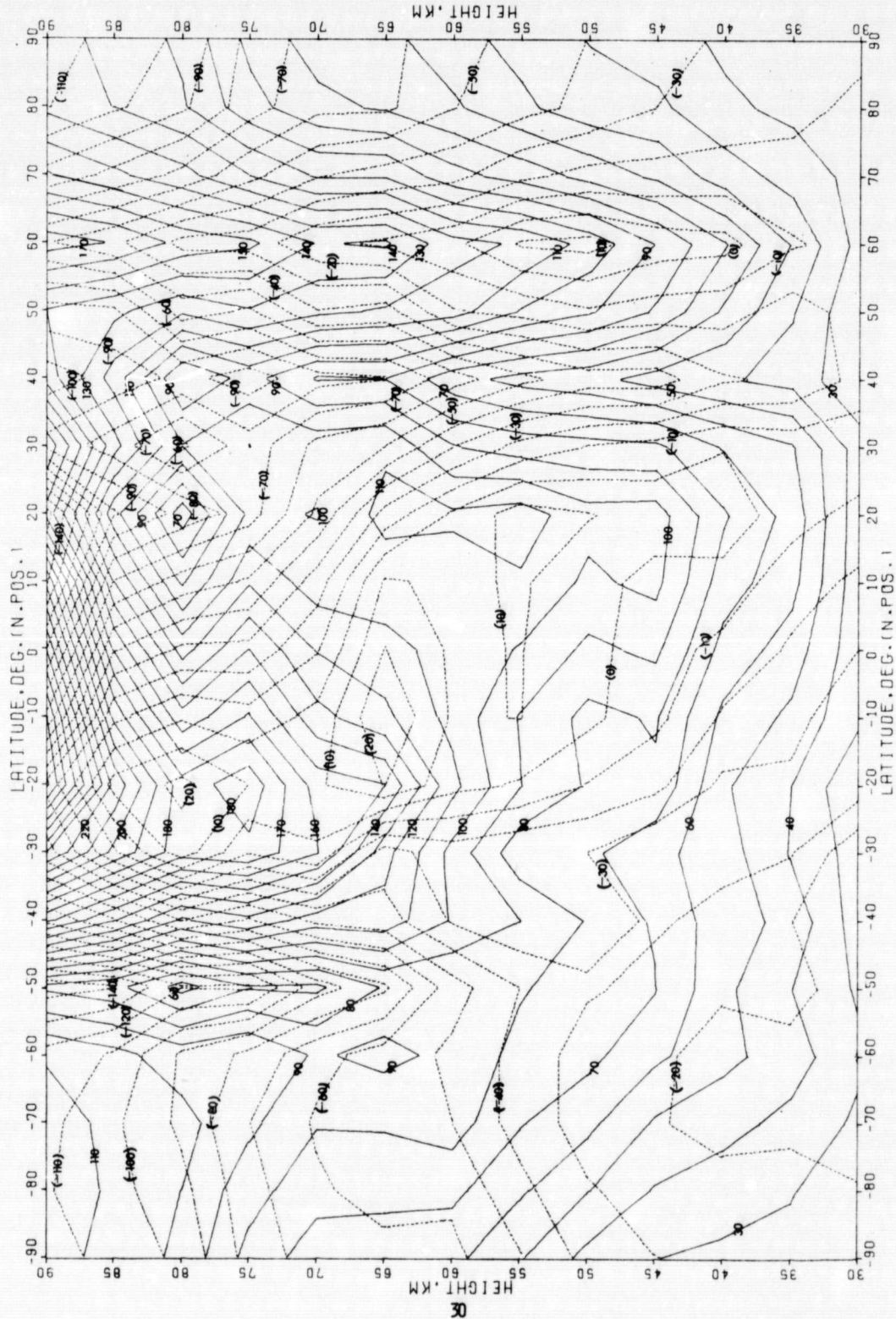


FIG 21

KEY-

— NORTHWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - STD. DEV. OF NORTHWARD WIND
 DURING MONTH OF APRIL

AT A LONGITUDE OF 80 DEGREES

WIND, M/S

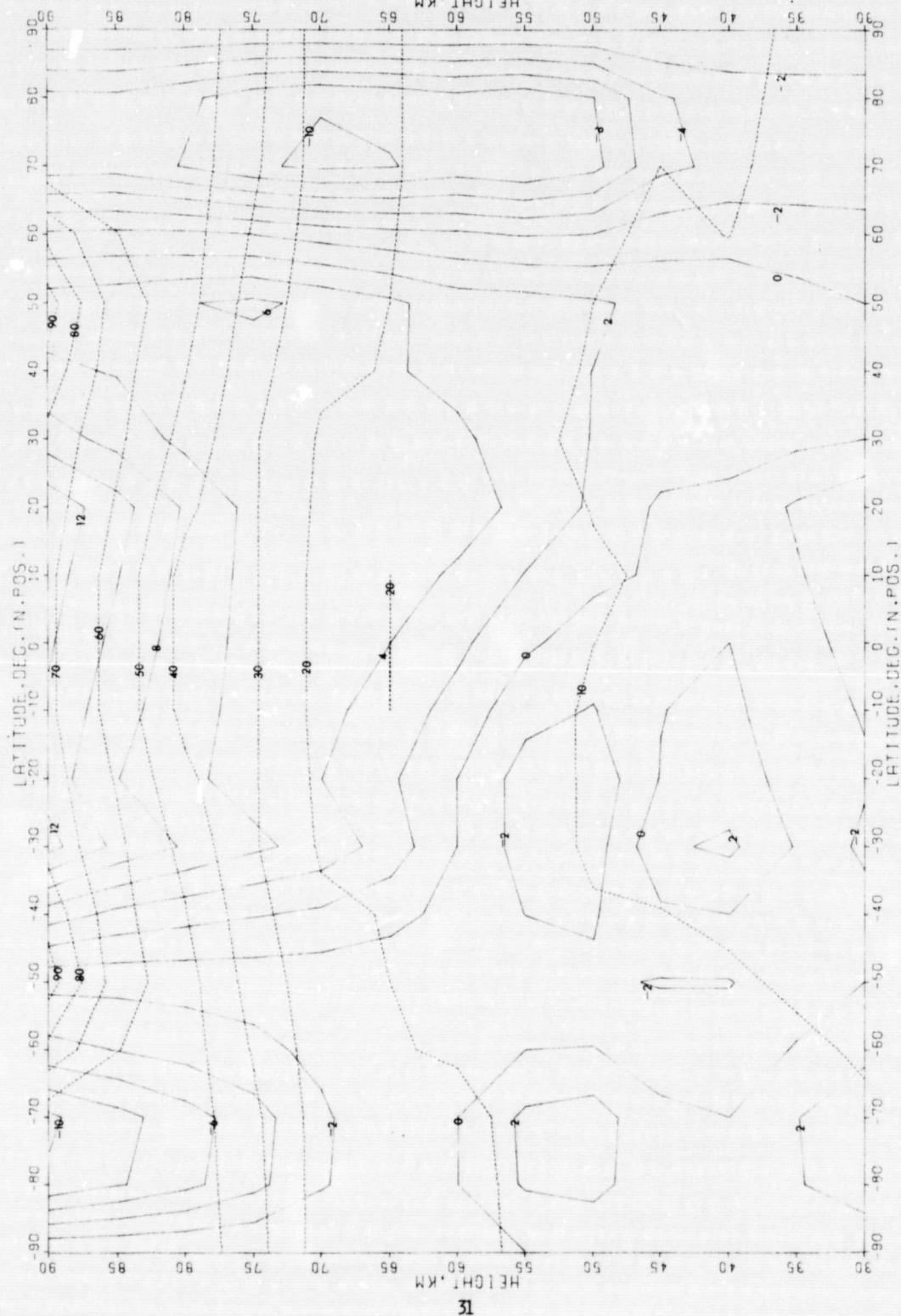
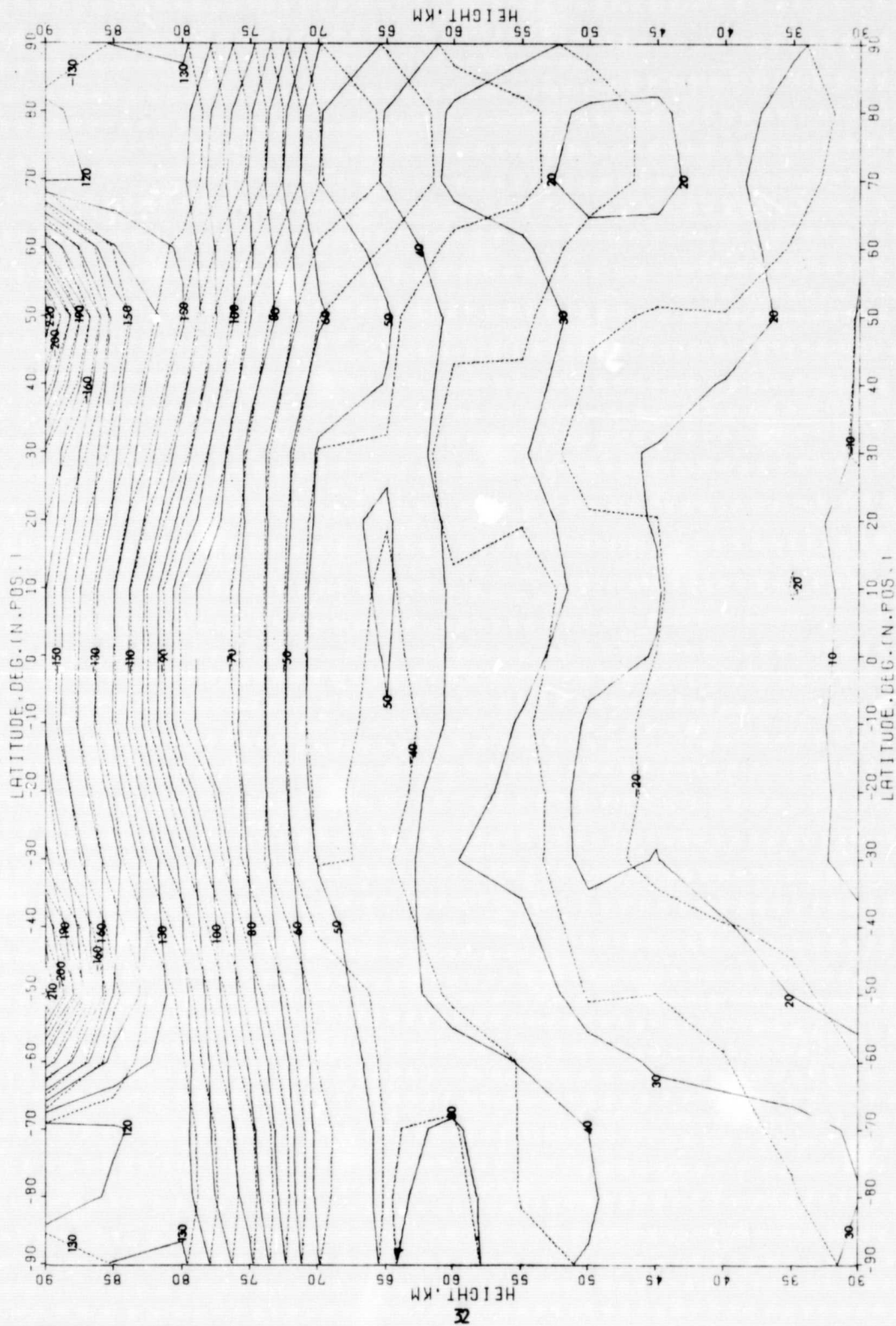


FIG 22

KEY-

—— UPPER 99TH PERCENTILE OF NORTHWARD WIND
 LOWER 99TH PERCENTILE OF NORTHWARD WIND
 DURING MONTH OF APRIL
 AT A LONGITUDE OF 80 DEGREES



KEY-

FIG 23

WIND SPEED M/S
STD. DEV. OF WIND SPEED
DURING MONTH OF APRIL
AT A LONGITUDE OF 80 DEGREES

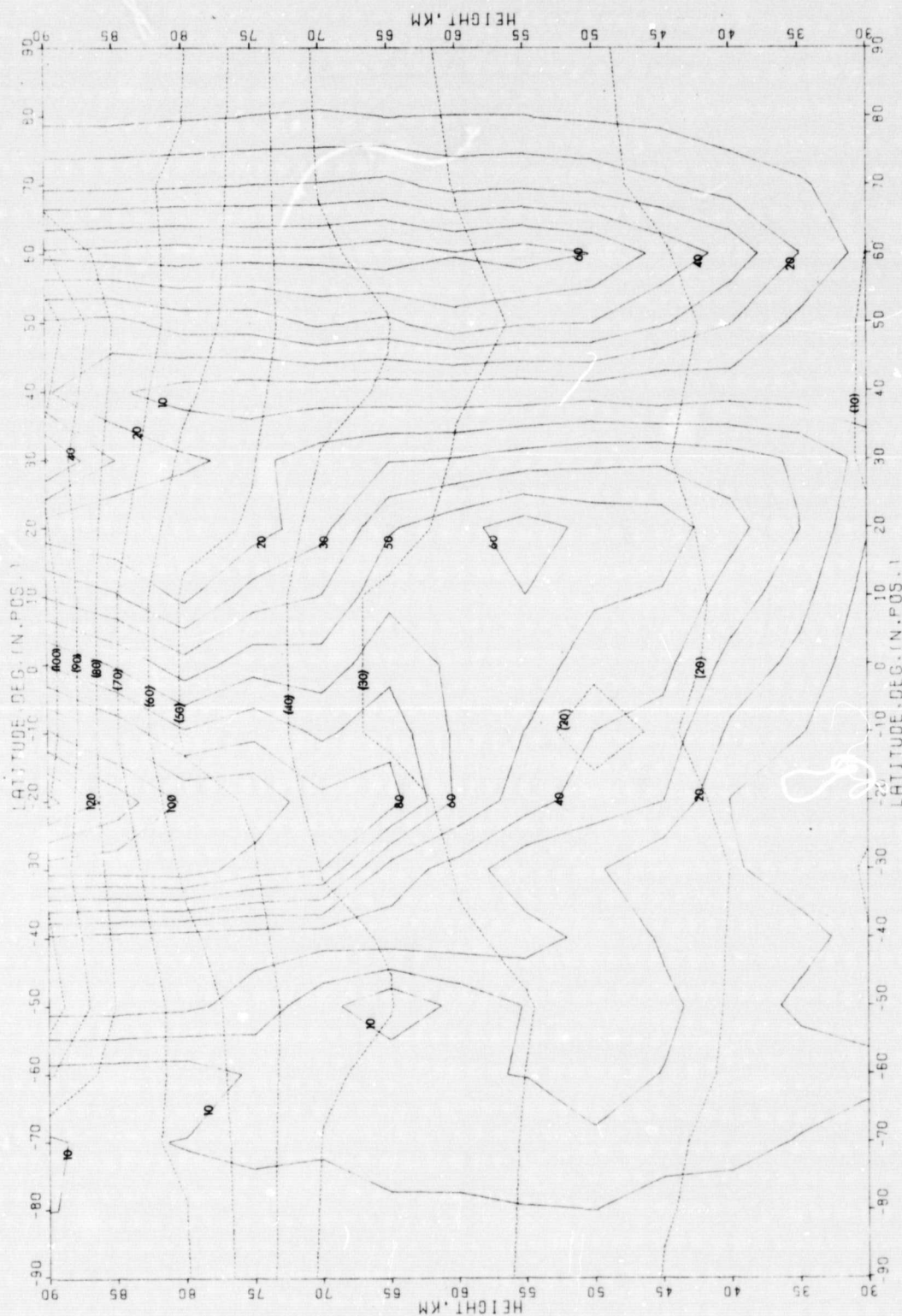


FIG 25

KEY-

----- PRESSURE, PER CENT DEV. FROM STD. ATM.
 STD. DEV. OF PRESSURE
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

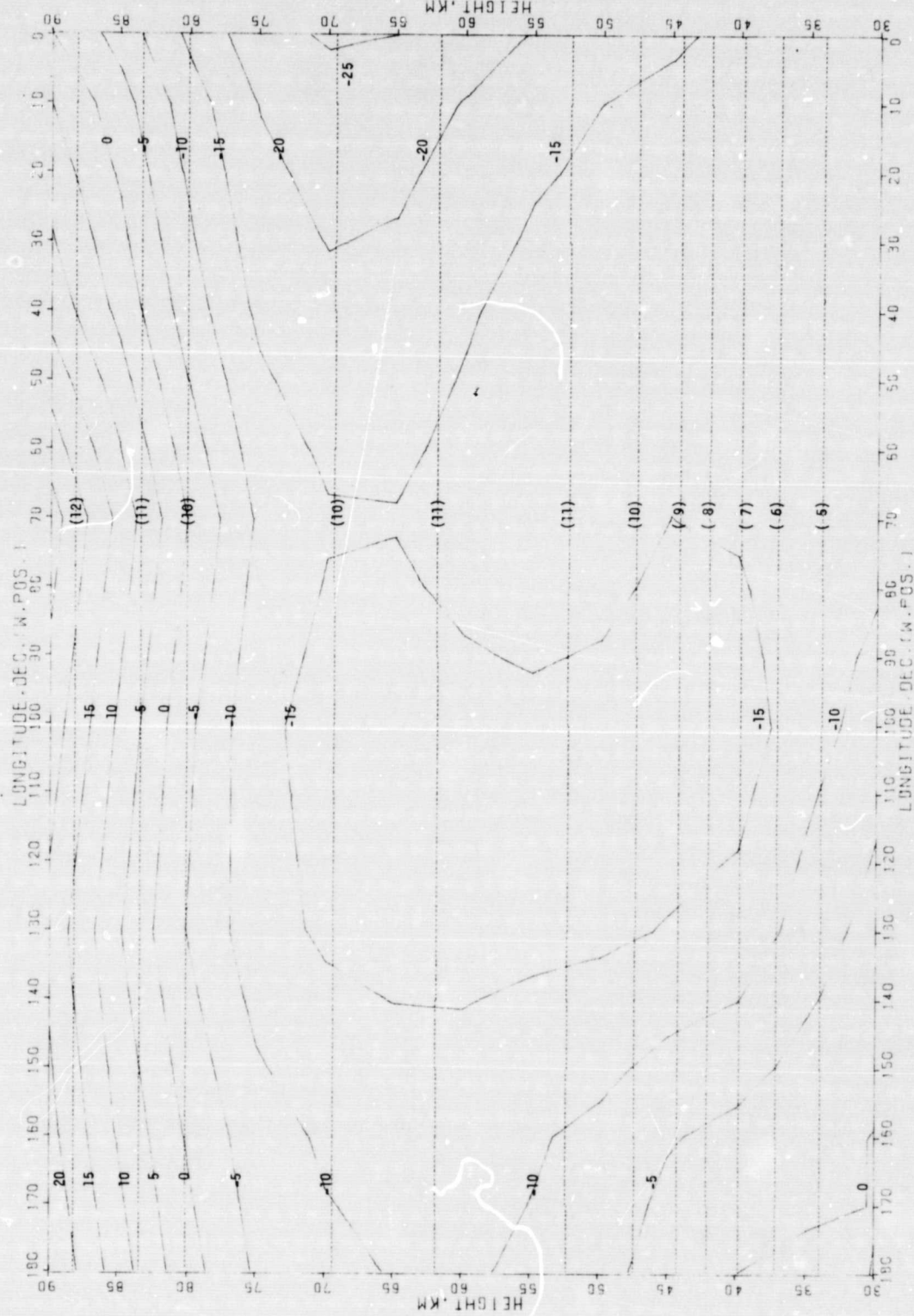


FIG 26

KEY-

— UPPER 99TH PERCENTILE OF PRESSURE
 - - - LOWER 99TH PERCENTILE OF PRESSURE
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

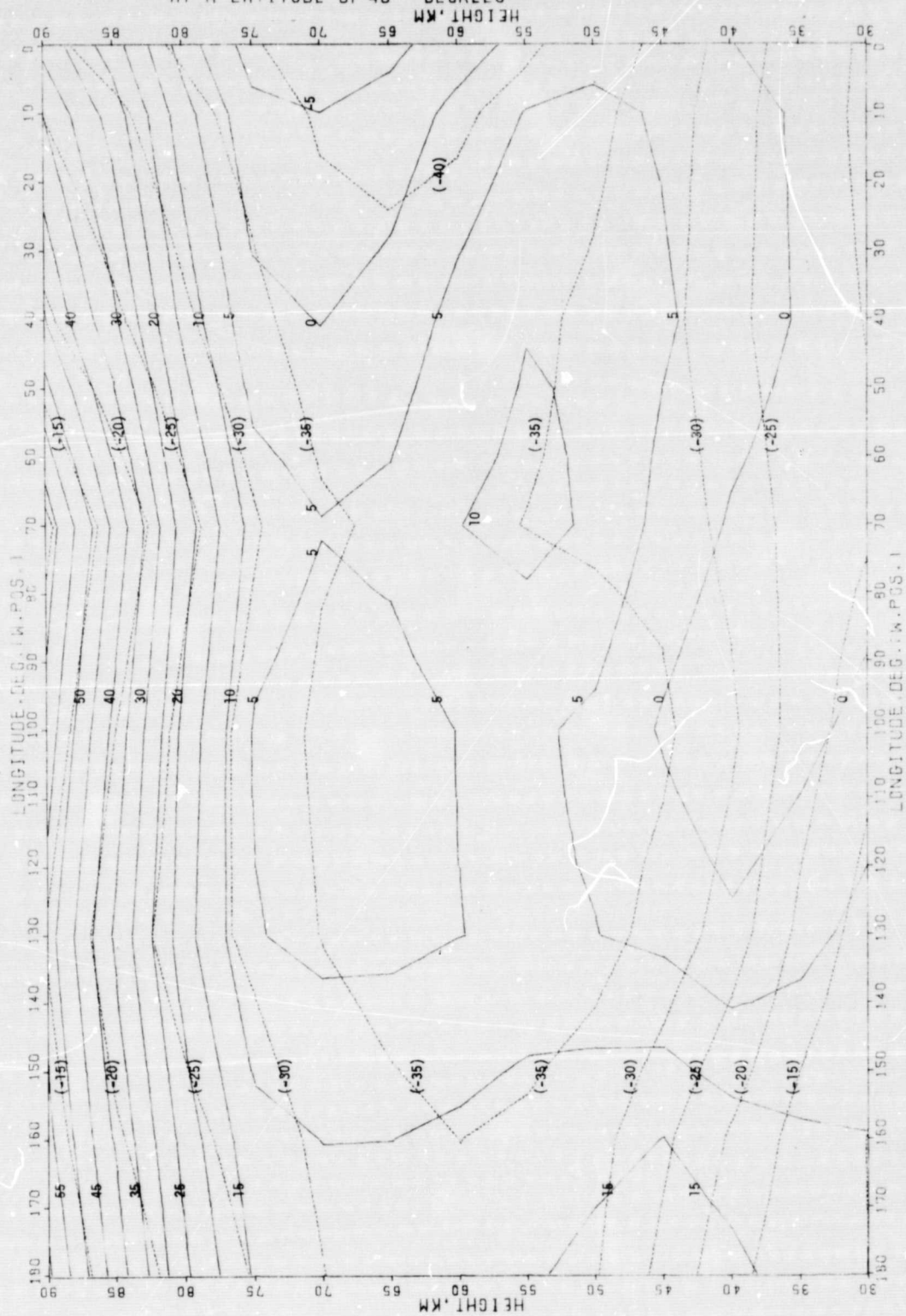


FIG 27

KEY-

----- DENSITY, PER CENT DEV. FROM STD. ATM.
 STD. DEV. OF DENSITY
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

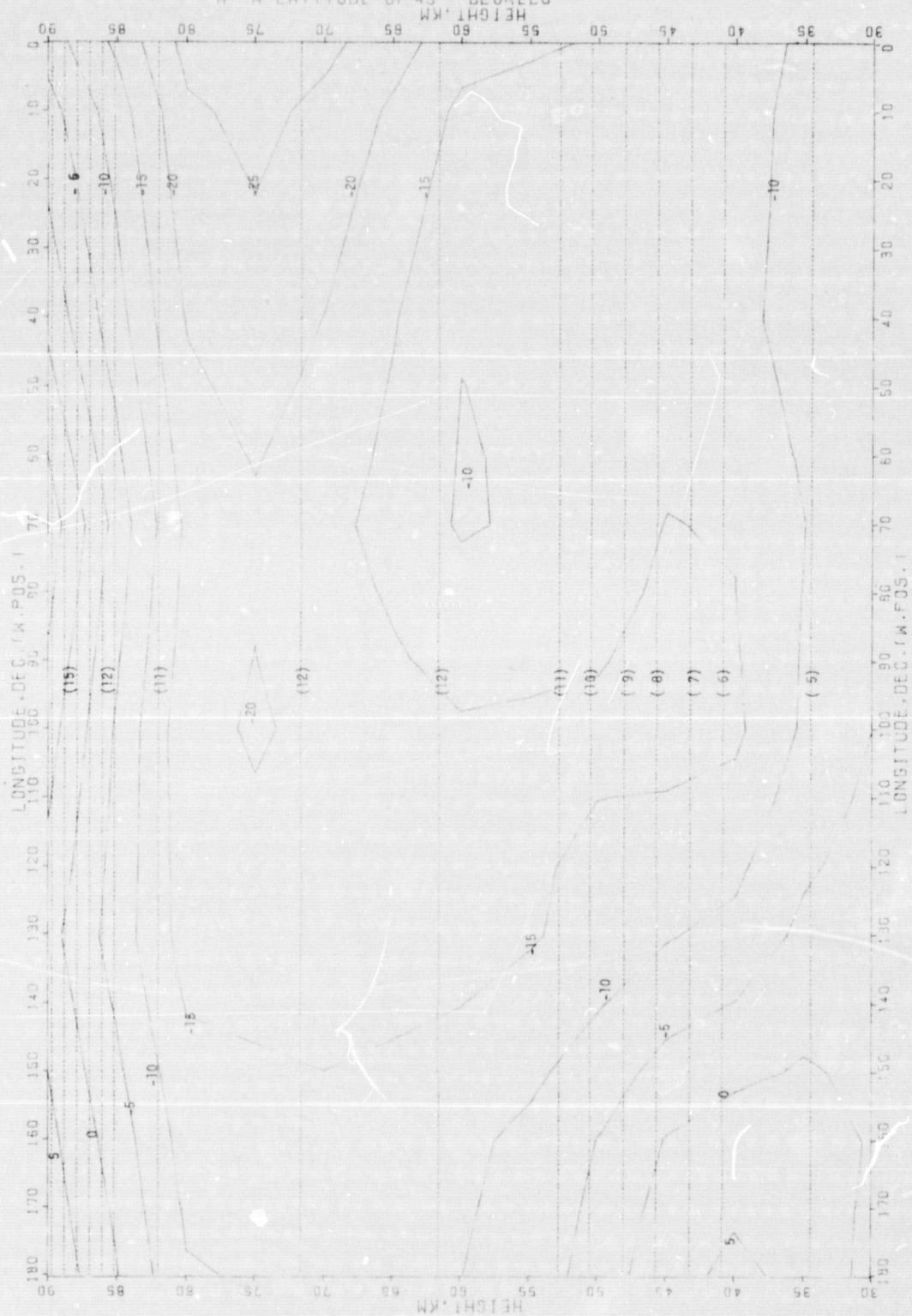


FIG 28

KEY-

— UPPER 99TH PERCENTILE OF DENSITY
 LOWER 99TH PERCENTILE OF DENSITY
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

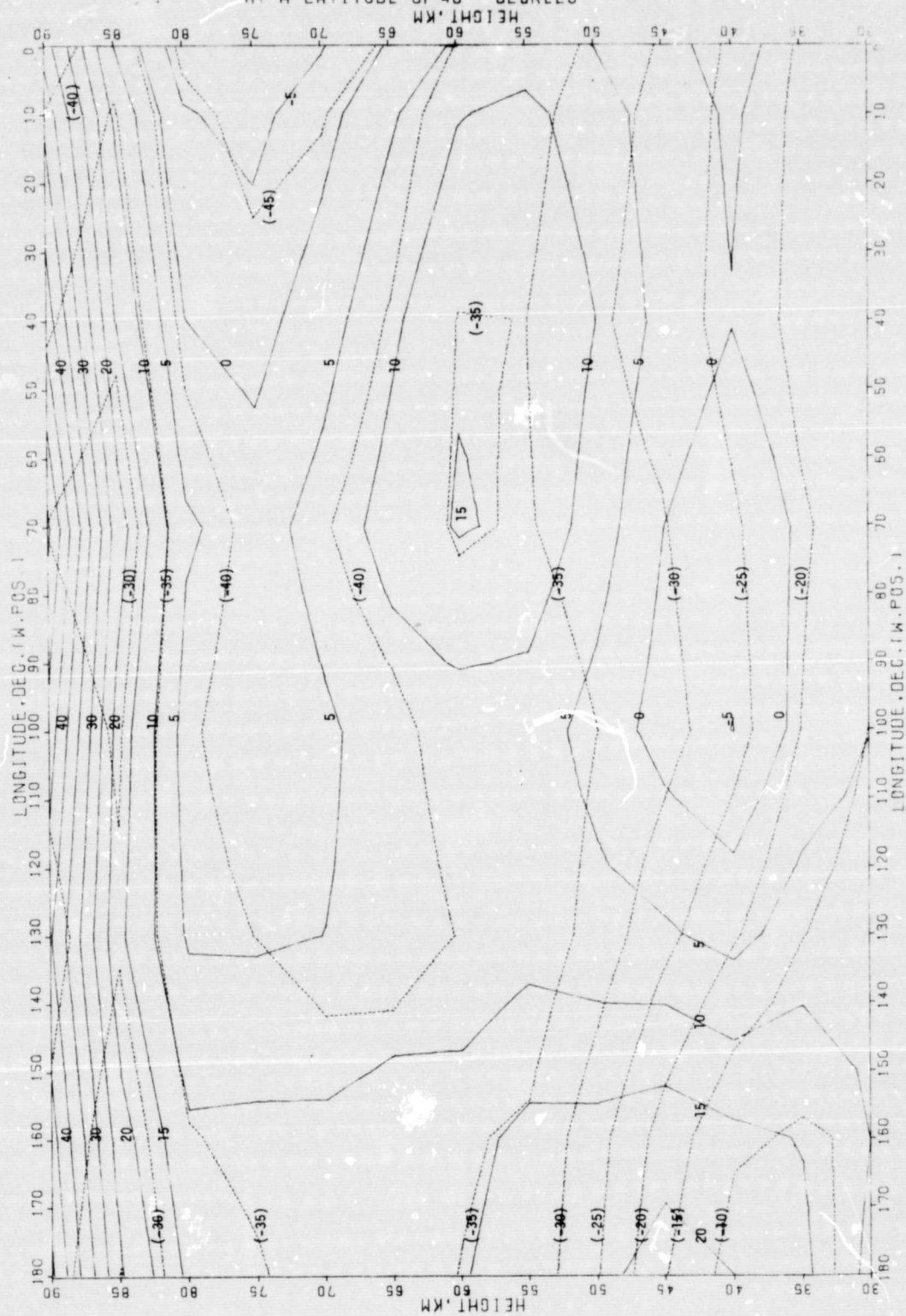
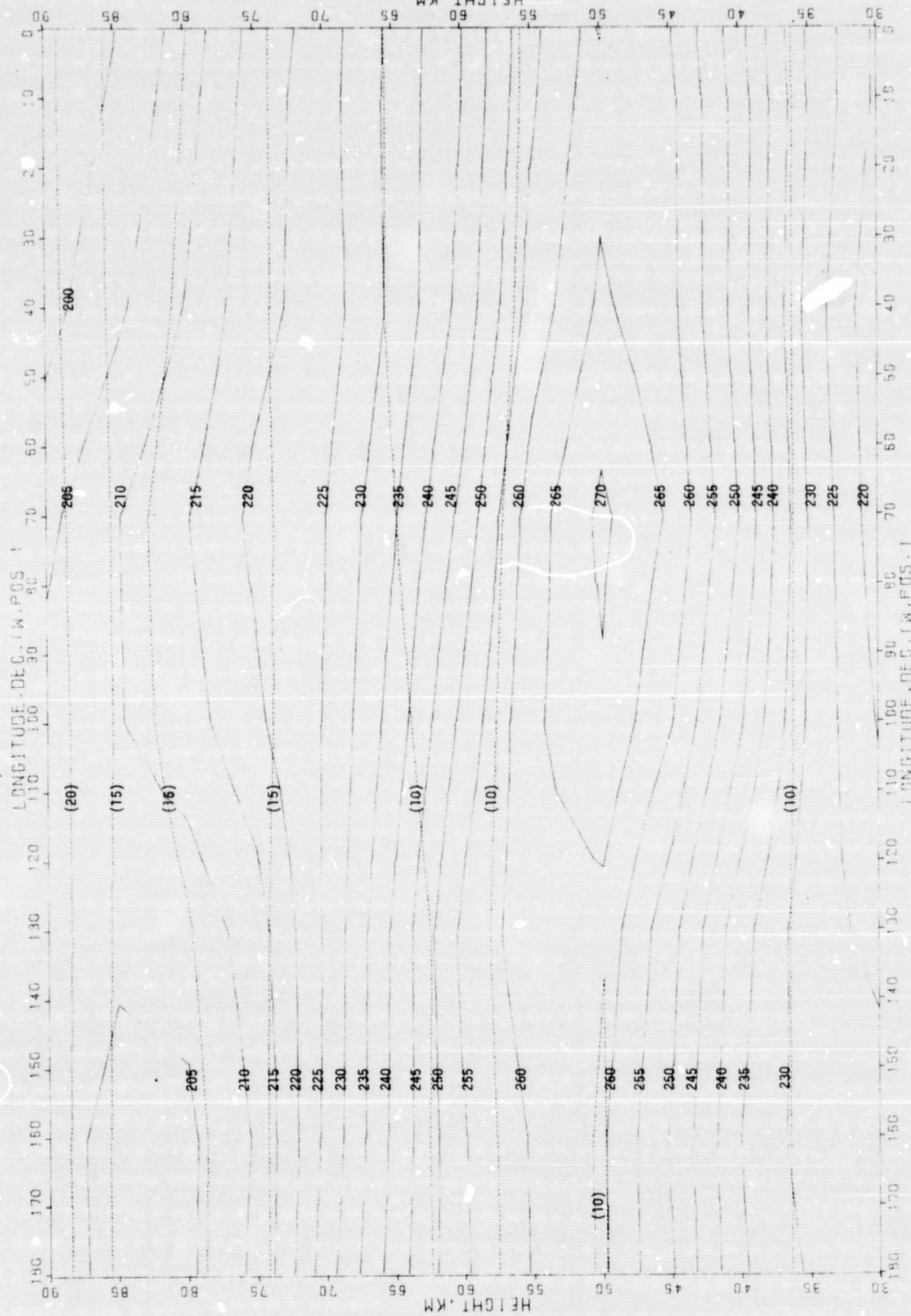


FIG 29

KEY-

----- TEMPERATURE, DEG. K
 STD. DEV. OF TEMPERATURE
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES
 WK. 14013H



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FC

LOWER 99TH PERCENTILE
 LOWER 99TH PERCENTILE OF
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

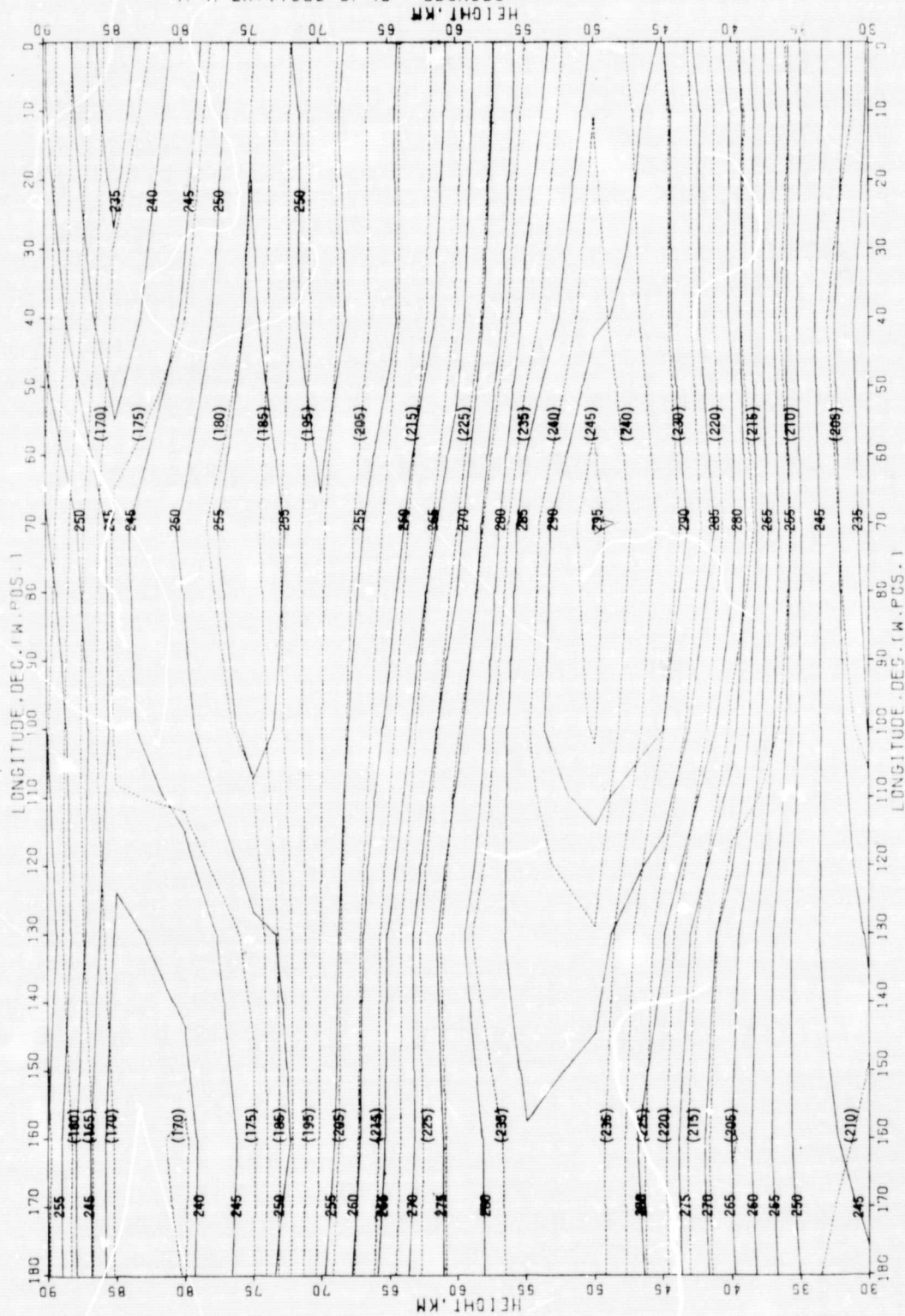
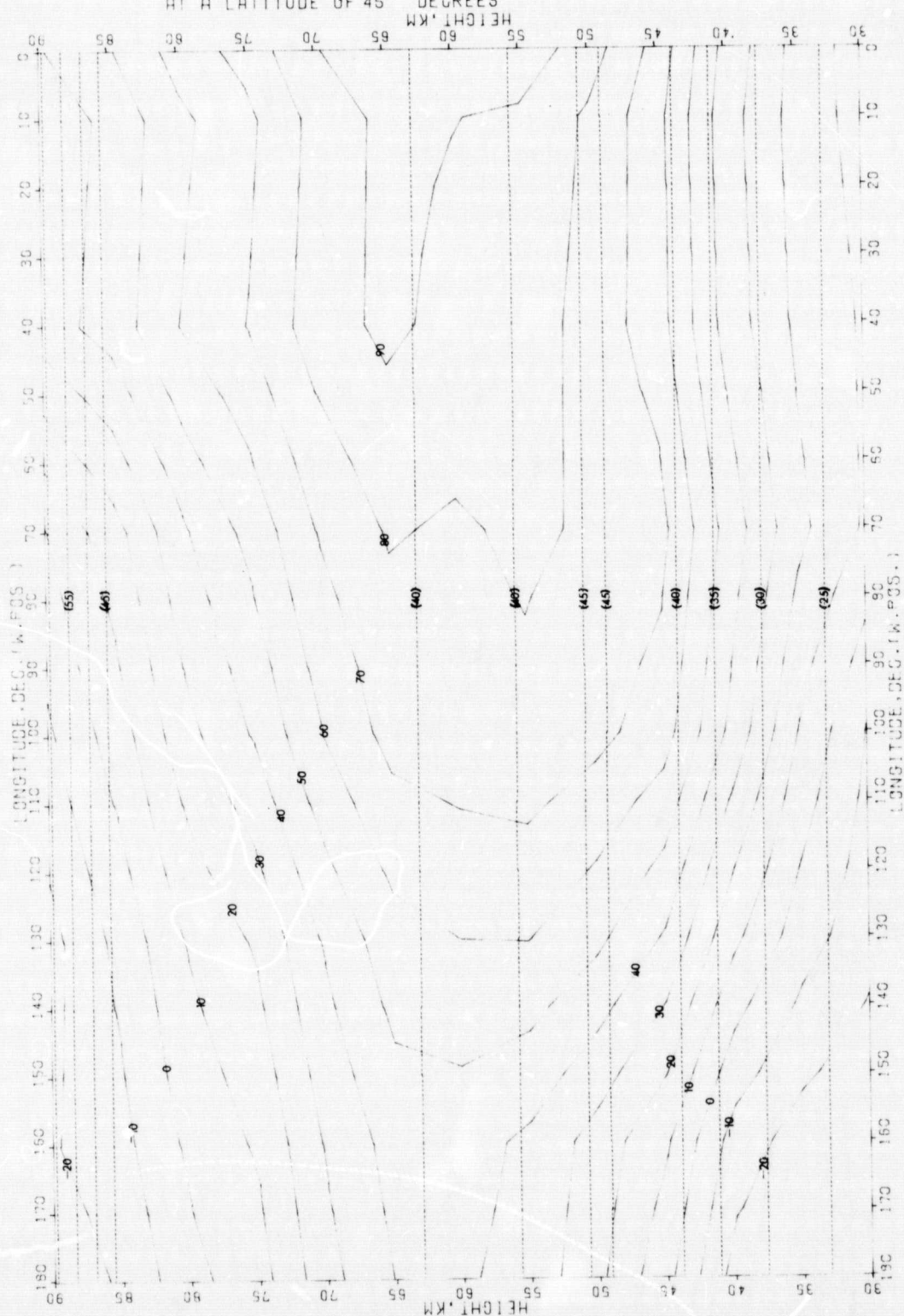


FIG 31

KEY-

— EASTWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - - - STD. DEV. OF EASTWARD WIND
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES



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FIG 32

KEY-

—— UPPER 99TH PERCENTILE OF EASTWARD WIND
 LOWER 99TH PERCENTILE OF EASTWARD WIND
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

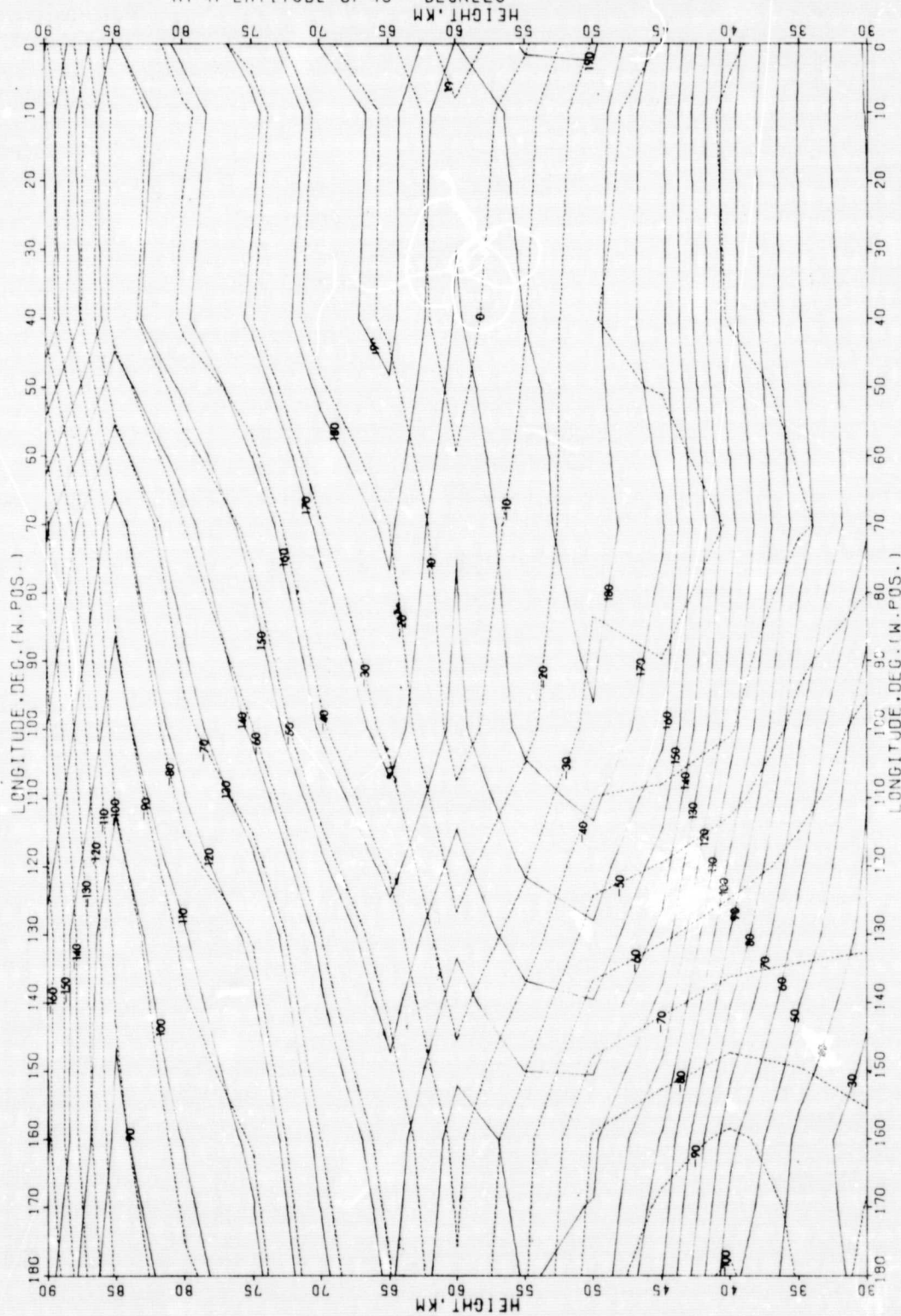


FIG 33

KEY-

— NORTHWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - - - STD. DEV. OF NORTHWARD WIND
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

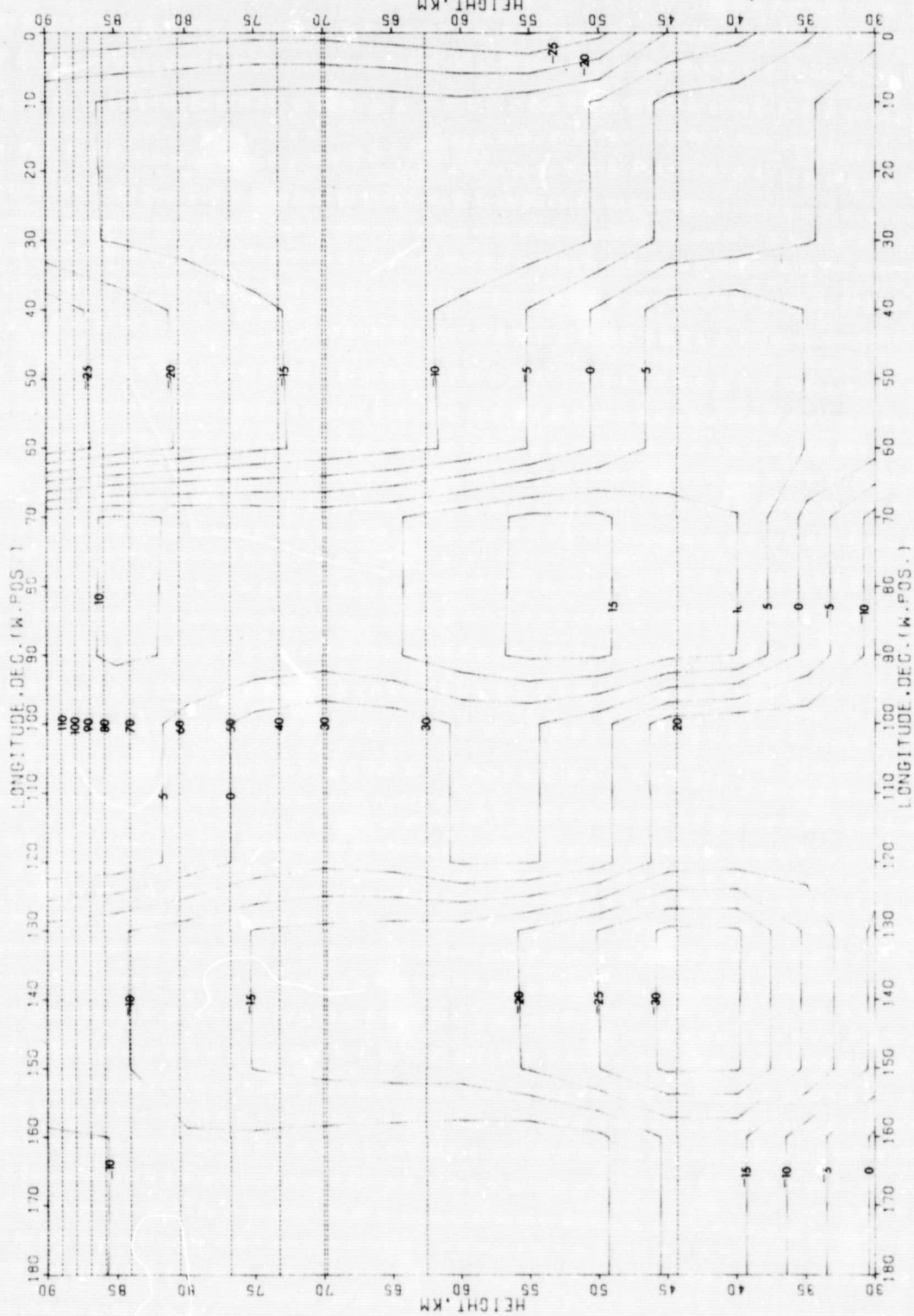


FIG 34

KEY-

----- UPPER 99TH PERCENTILE OF NORTHWARD WIND
 LOWER 99TH PERCENTILE OF NORTHWARD WIND
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

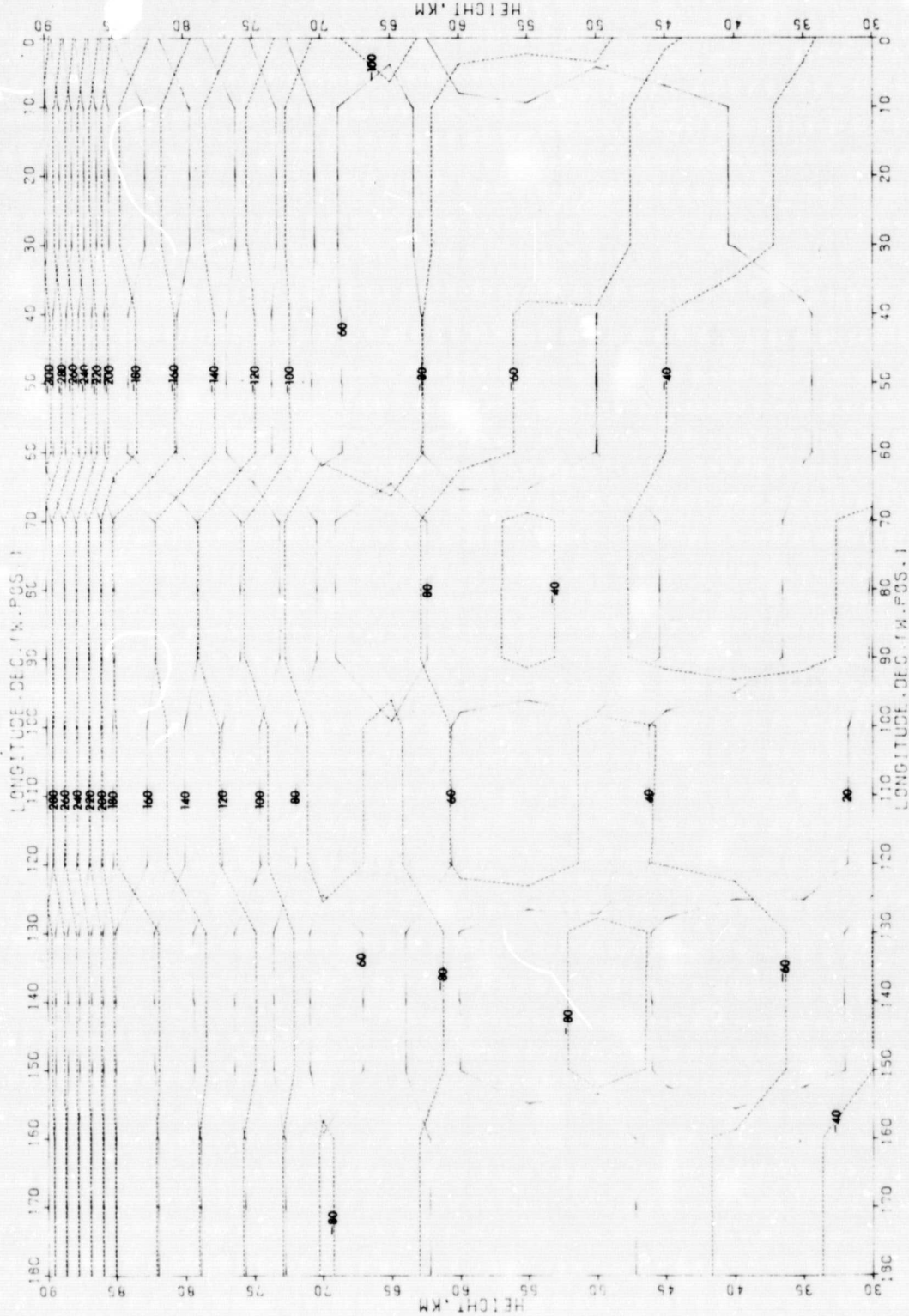


FIG 35

KEY-

— WIND SPEED M/S
 - - - - - STD. DEV. OF WIND SPEED
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

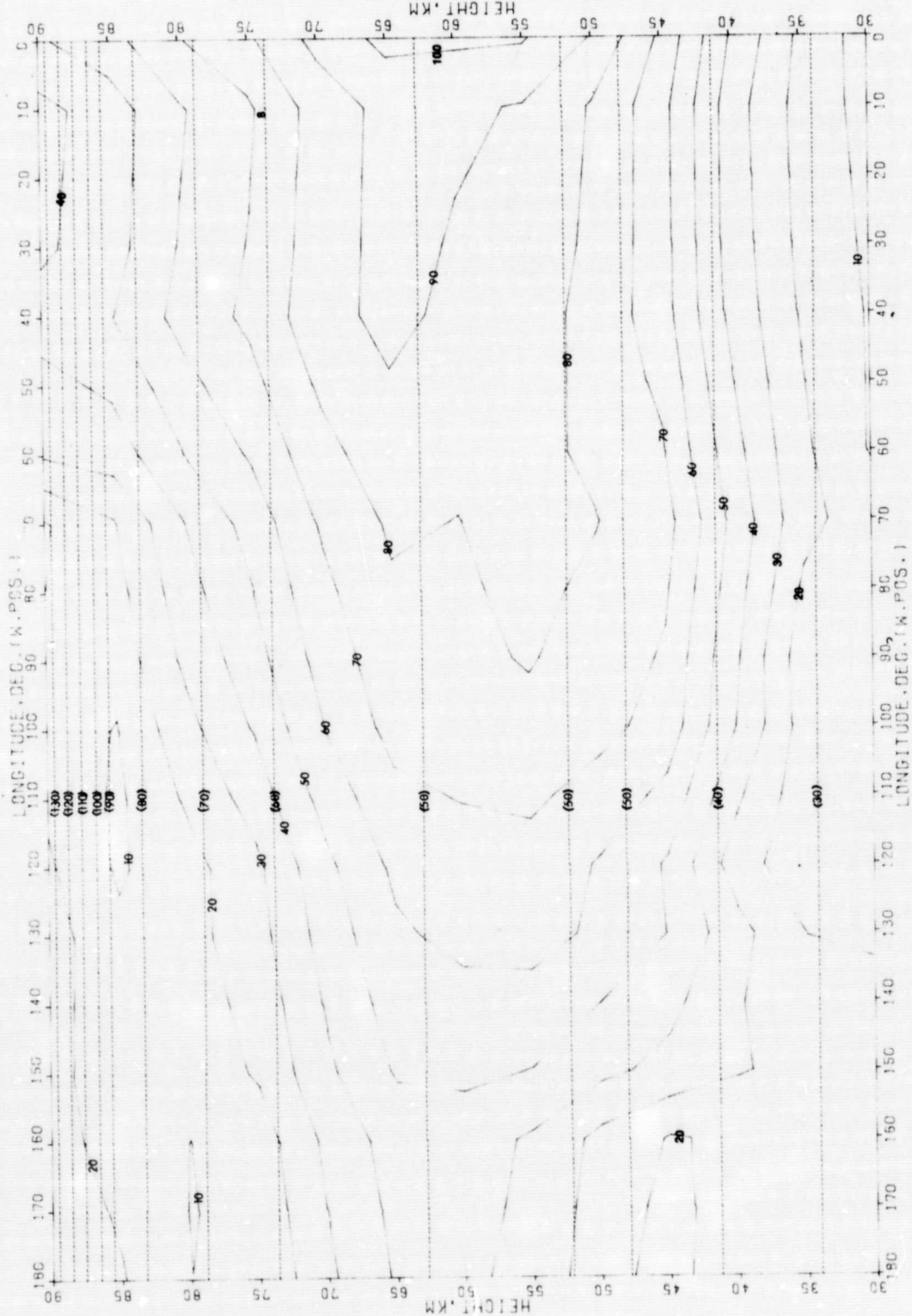


FIG 36

KEY-

—— UPPER 99TH PERCENTILE OF WIND SPEED
 - - - - LOWER 99TH PERCENTILE OF WIND SPEED
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

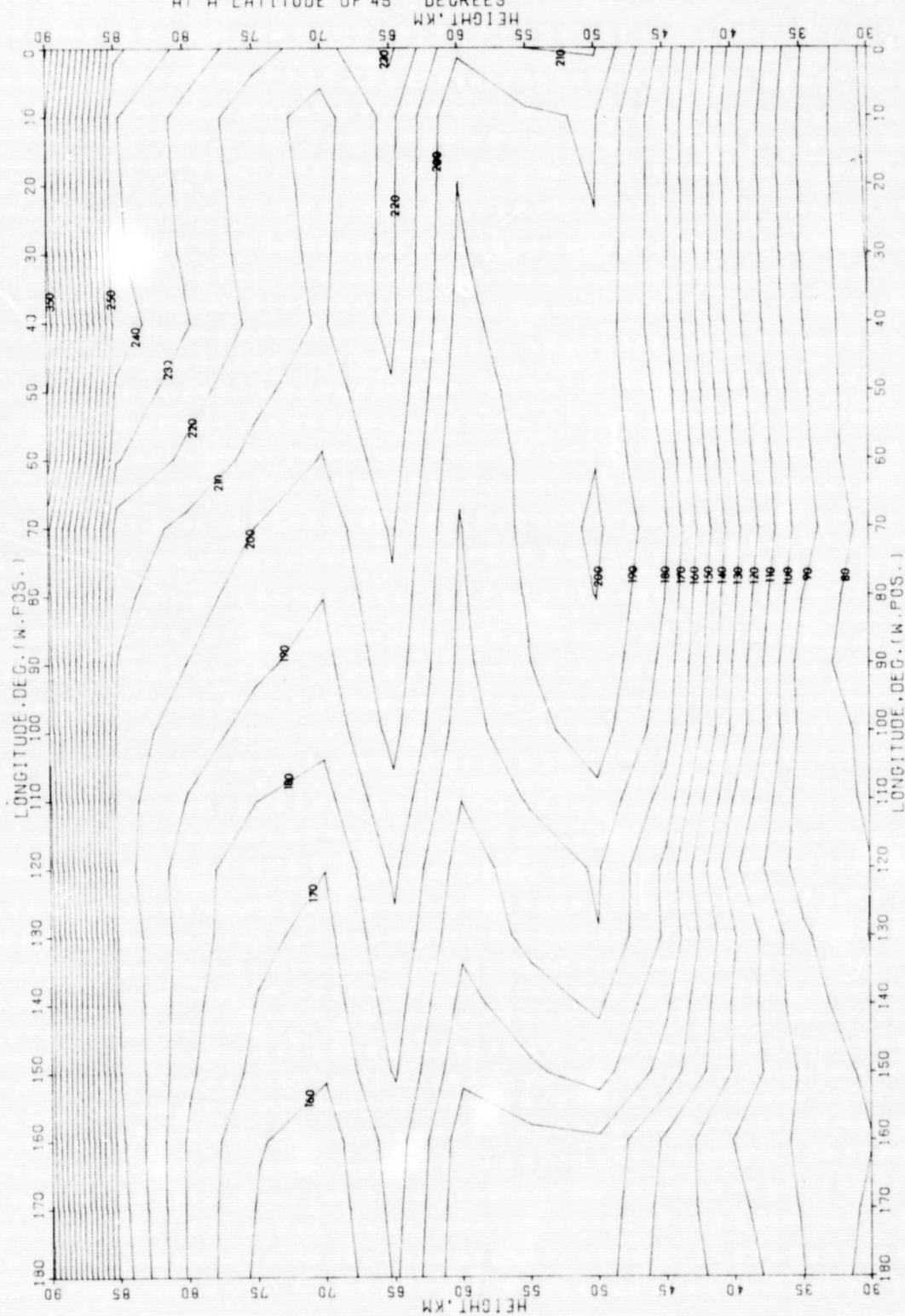


FIG 37

KEY-

— PRESSURE, PER CENT DEV. FROM STD. ATM.
 - - - STD. DEV. OF PRESSURE
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

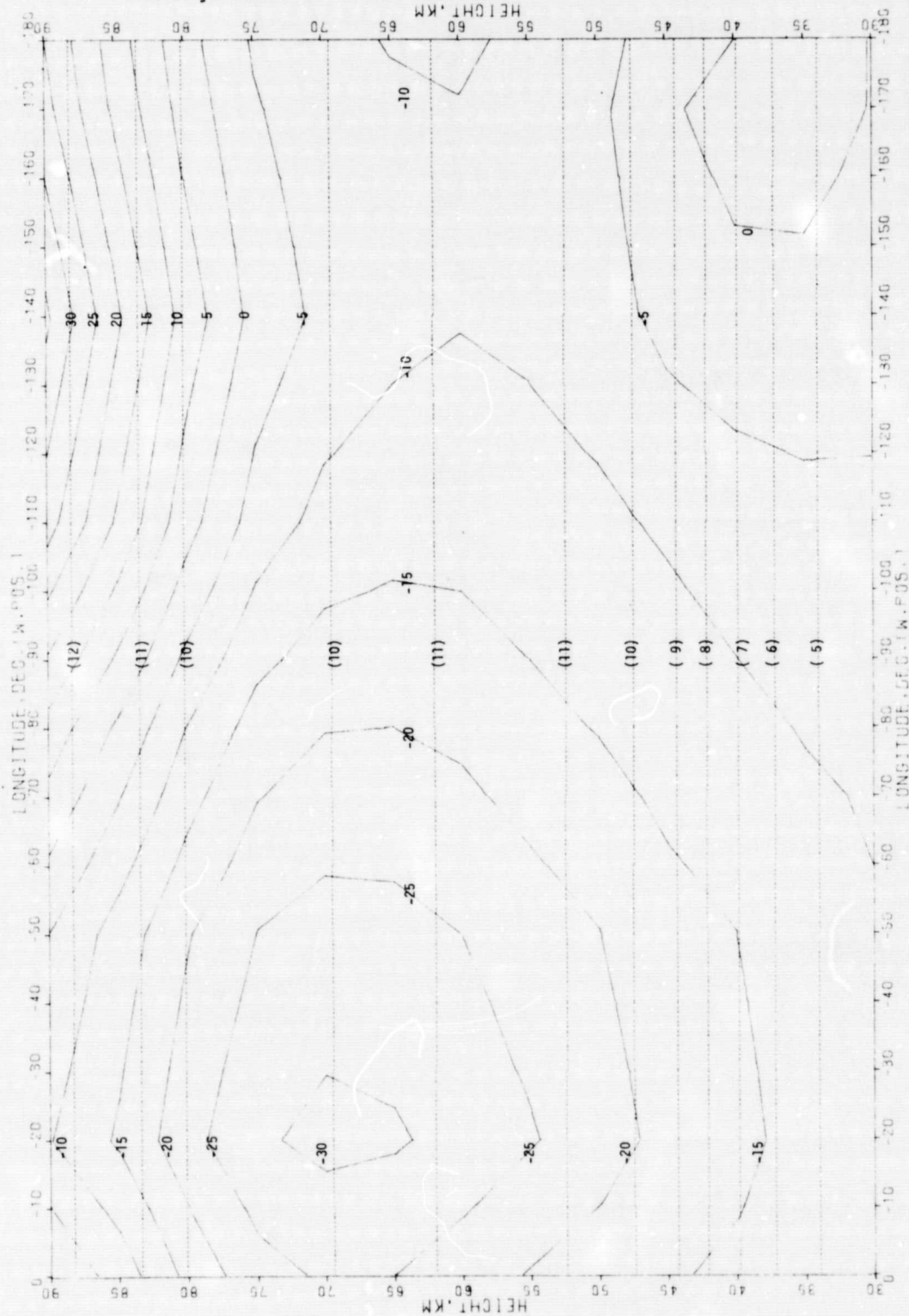


FIG 38

KEY-

— UPPER 99TH PERCENTILE OF PRESSURE
 - - - LOWER 99TH PERCENTILE OF PRESSURE
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

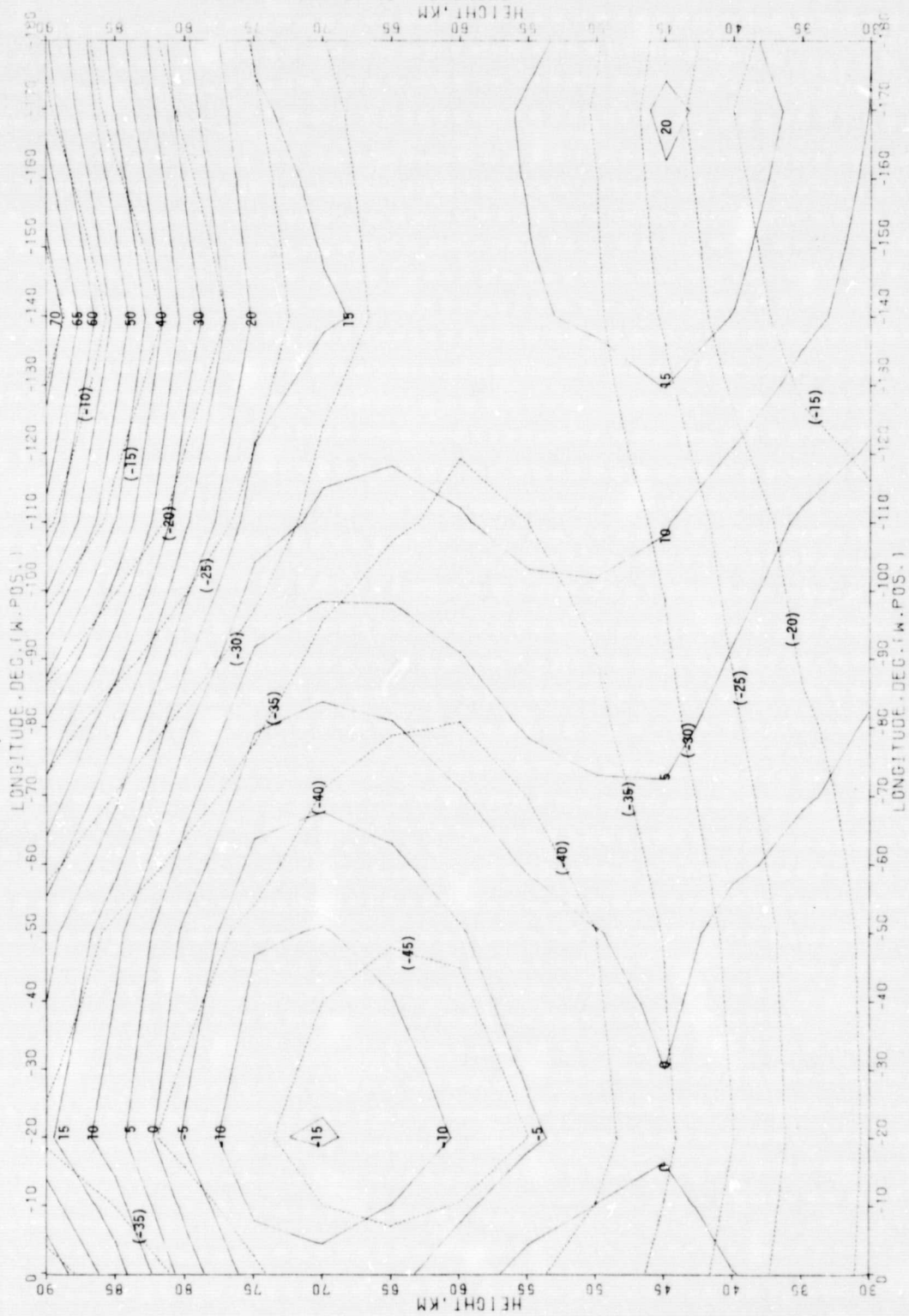


FIG 39

KEY-

— DENSITY, PER CENT DEV. FROM STD. ATM.
 STD. DEV. OF DENSITY
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES



Page 32

FIG 40

KEY-

— UPPER 99TH PERCENTILE OF DENSITY
- - - LOWER 99TH PERCENTILE OF DENSITY
DURING MONTH OF JANUARY
AT A LATITUDE OF 45 DEGREES

WY 1961/62

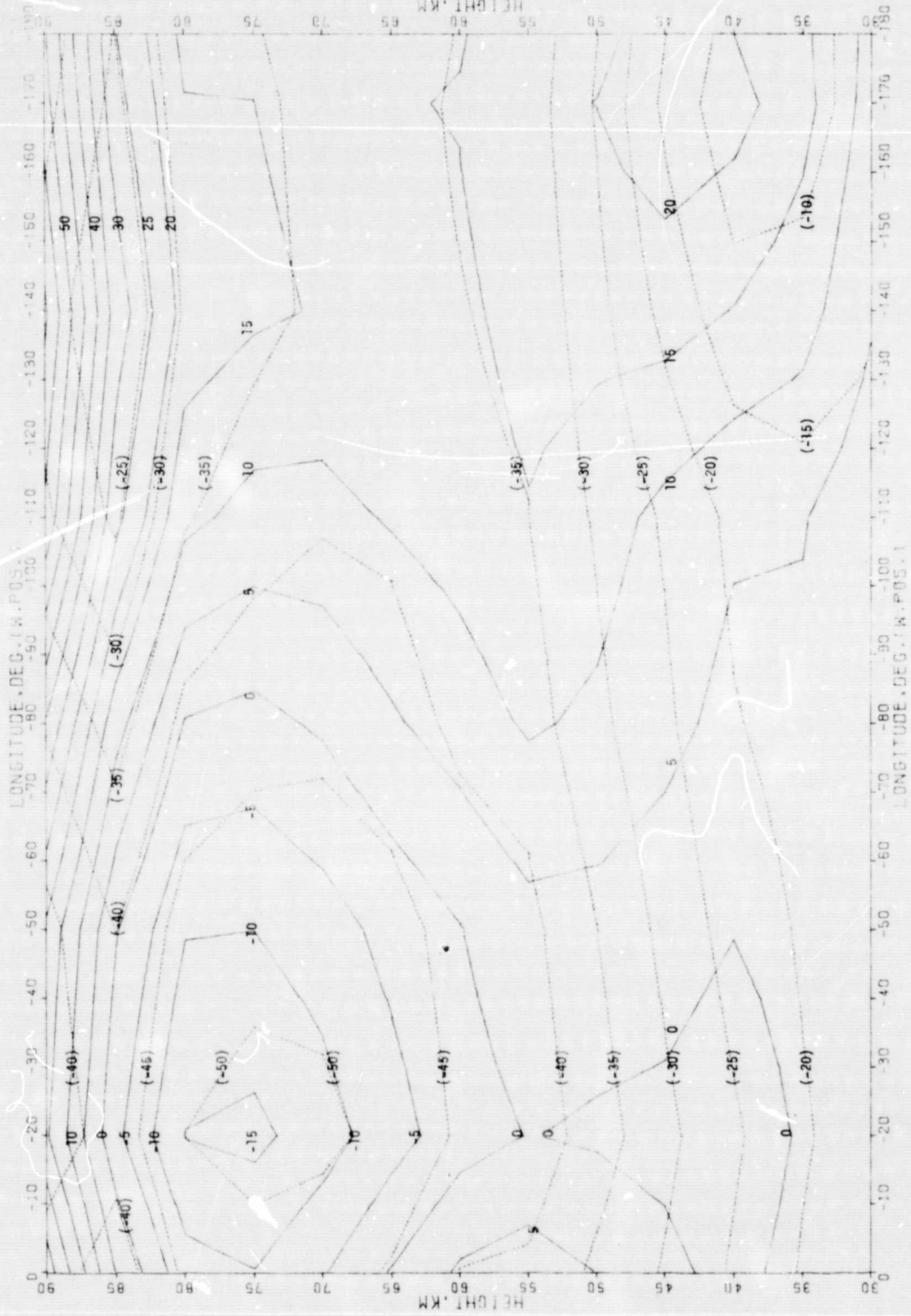
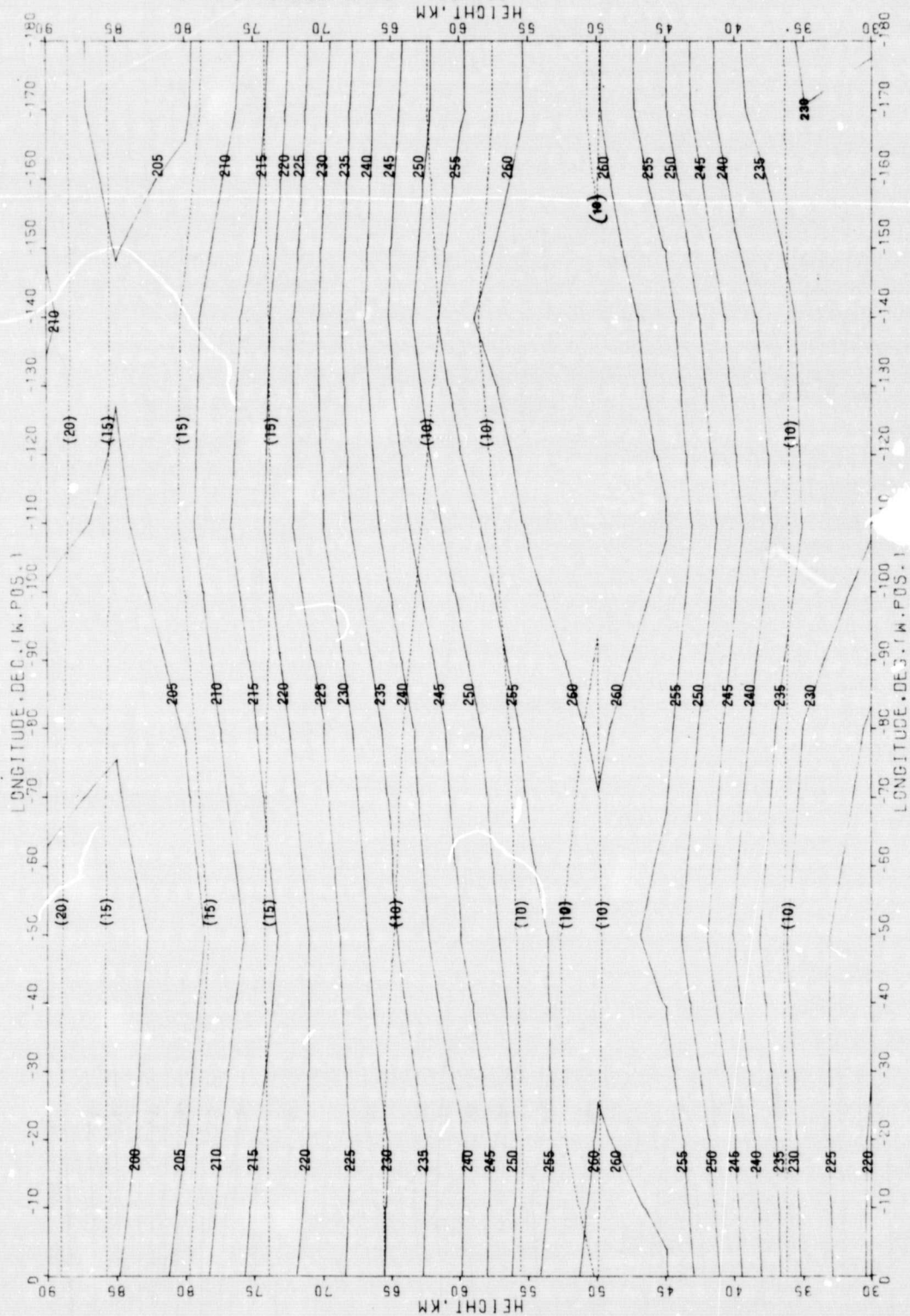


FIG 41

KEY-

— TEMPERATURE, DEG. K
 - - - STD. DEV. OF TEMPERATURE
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES



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FIG 42

KEY-

—— UPPER 99TH PERCENTILE OF TEMPERATURE
 - - - - LOWER 99TH PERCENTILE OF TEMPERATURE
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

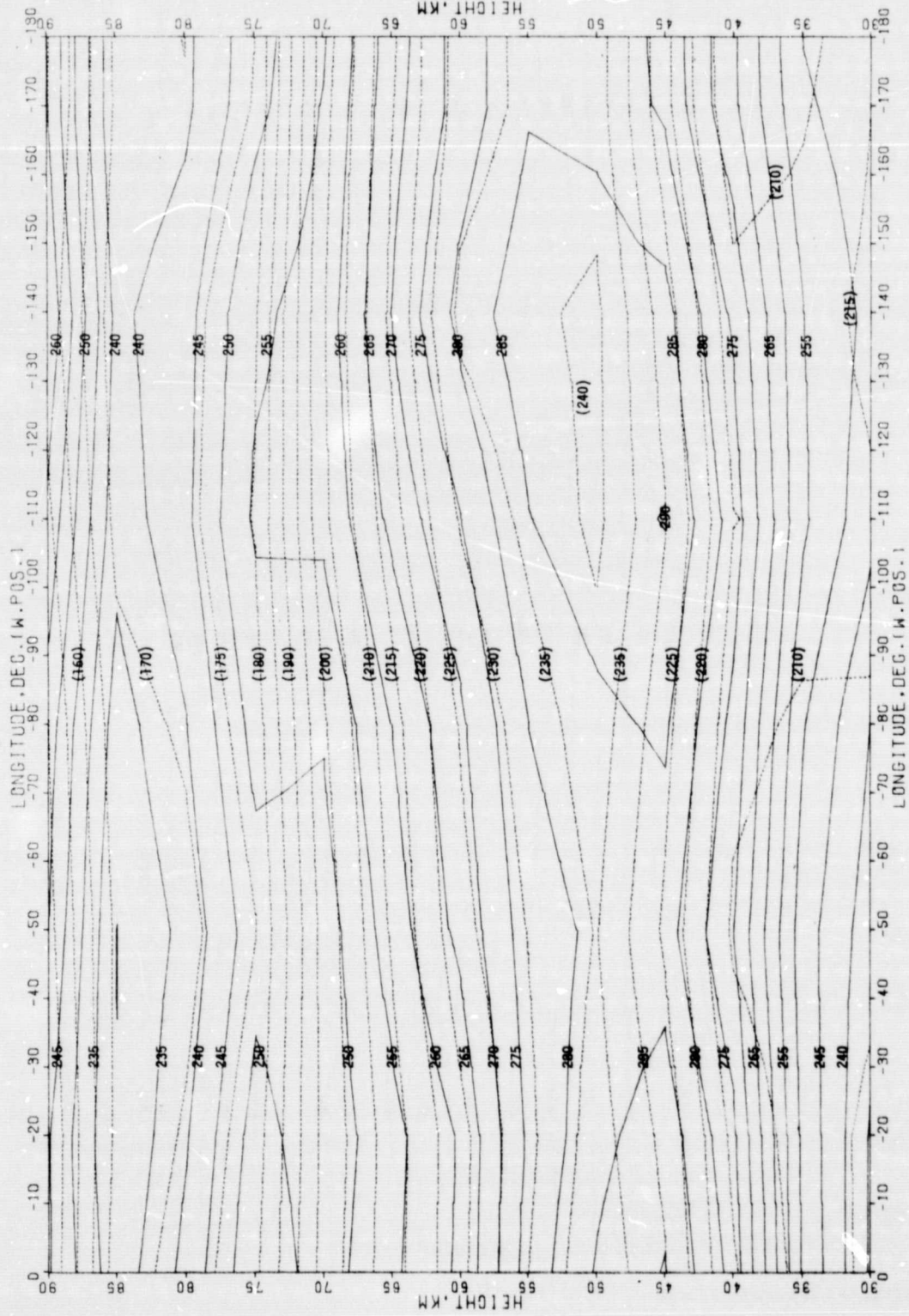
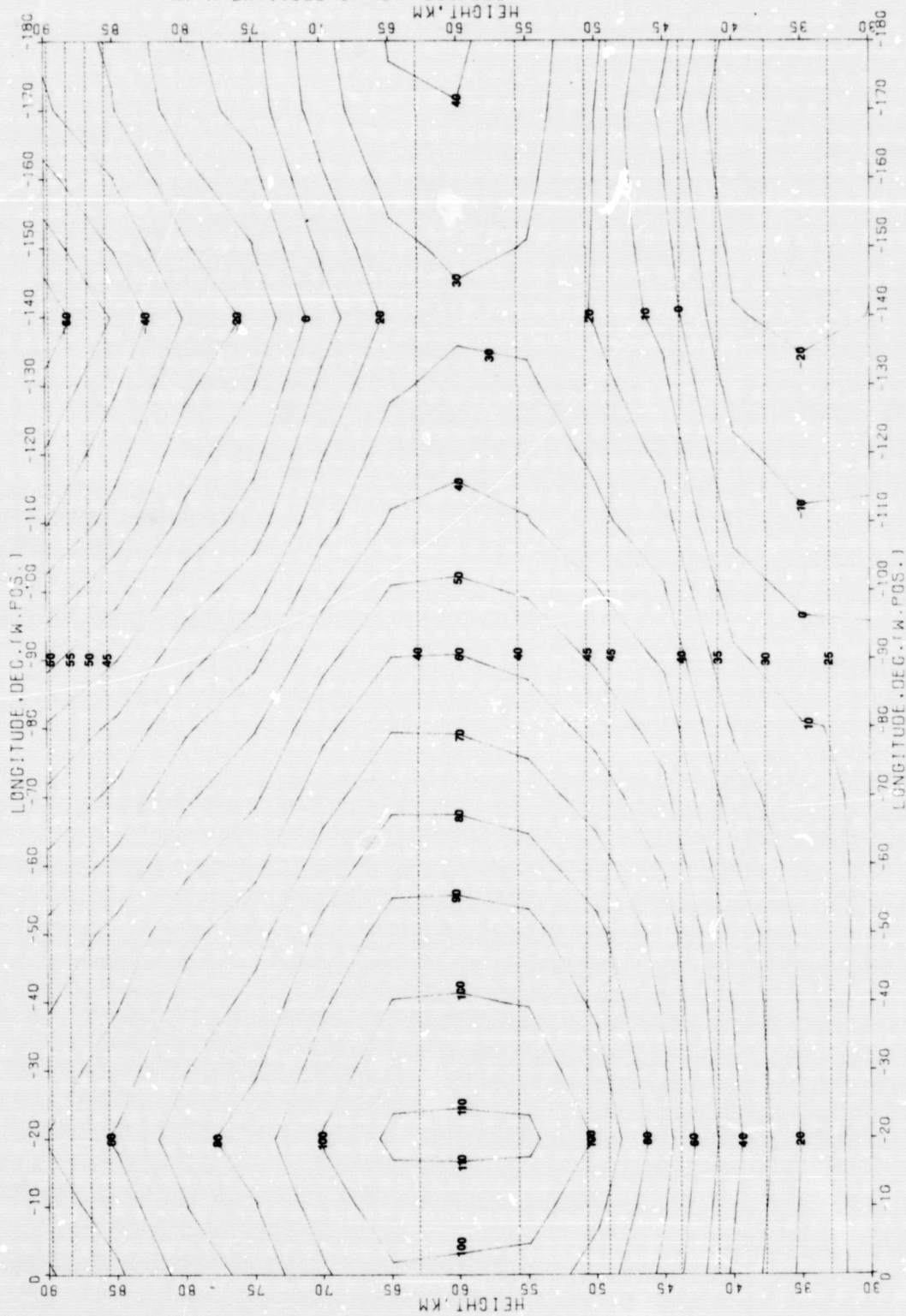


FIG 43

KEY-

—— EASTWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - - - STD. DEV. OF EASTWARD WIND
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES



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FIG 44

KEY-

—— UPPER 99TH PERCENTILE OF EASTWARD WIND
 LOWER 99TH PERCENTILE OF EASTWARD WIND
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

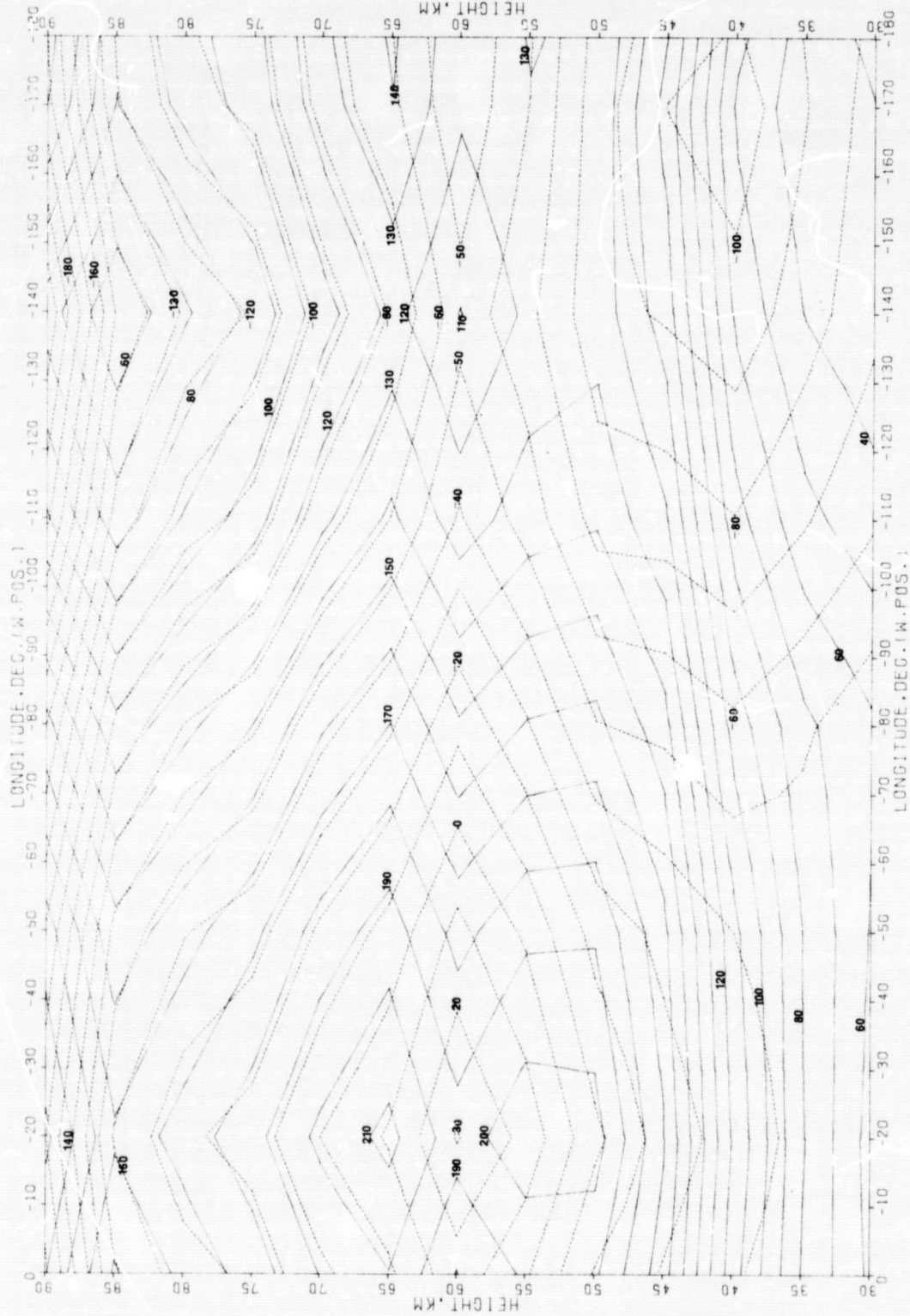
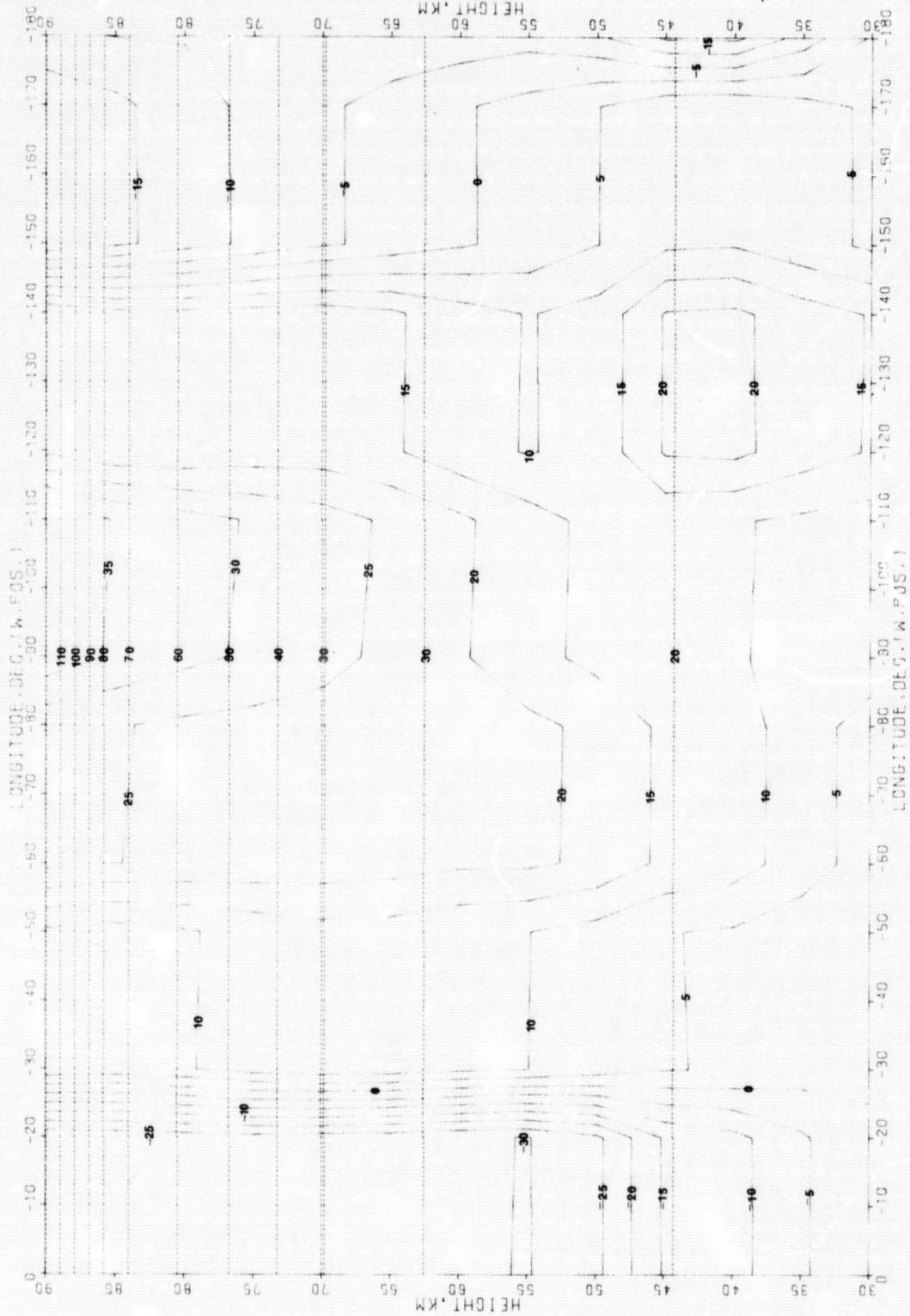


FIG 45

KEY -

— NORTHWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - STD. DEV. OF NORTHWARD WIND
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES



KEY Y =

HEIGHT, KM

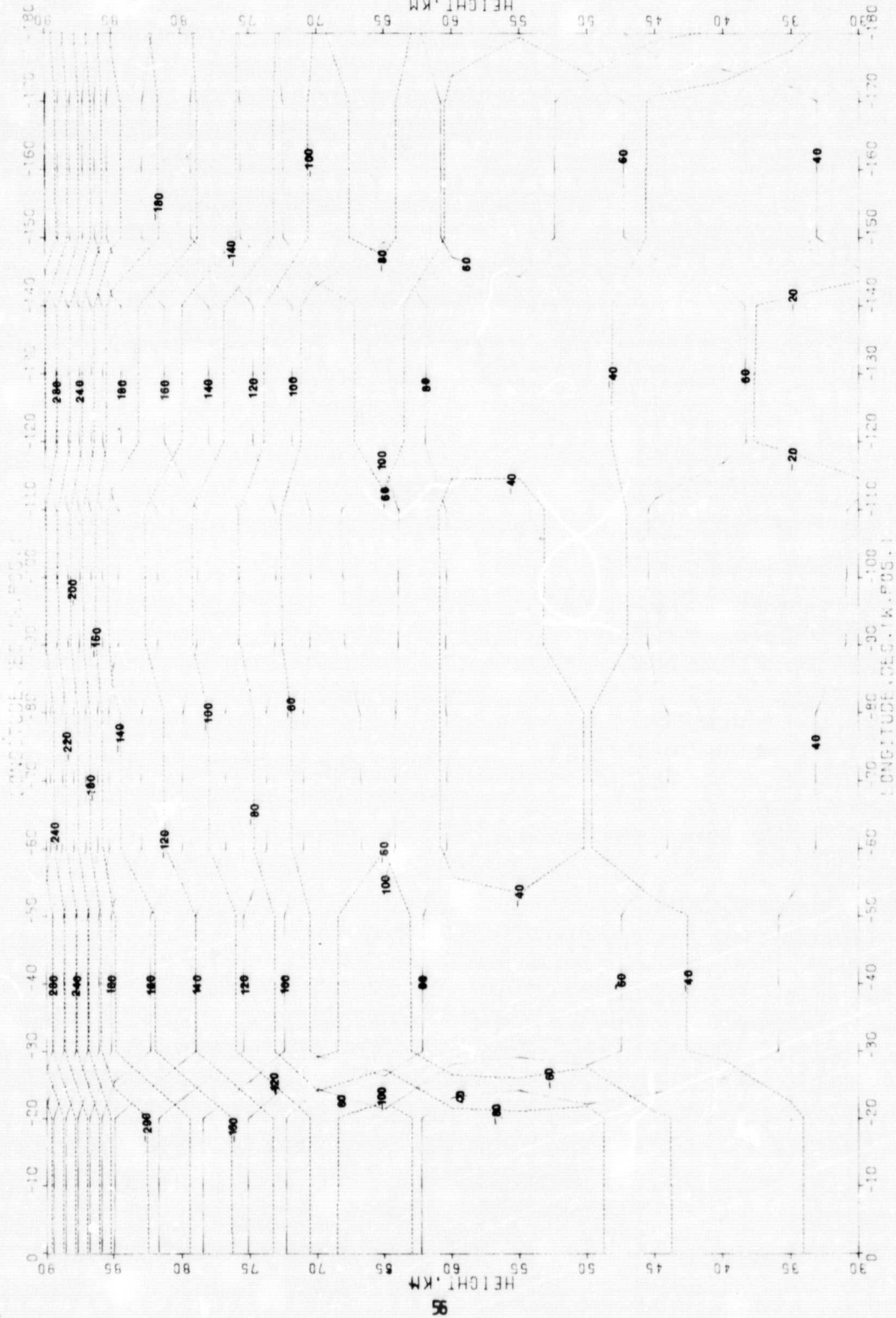


FIG 47

KEY-

— WIND SPEED M/S
 - - - STD. DEV. OF WIND SPEED
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES

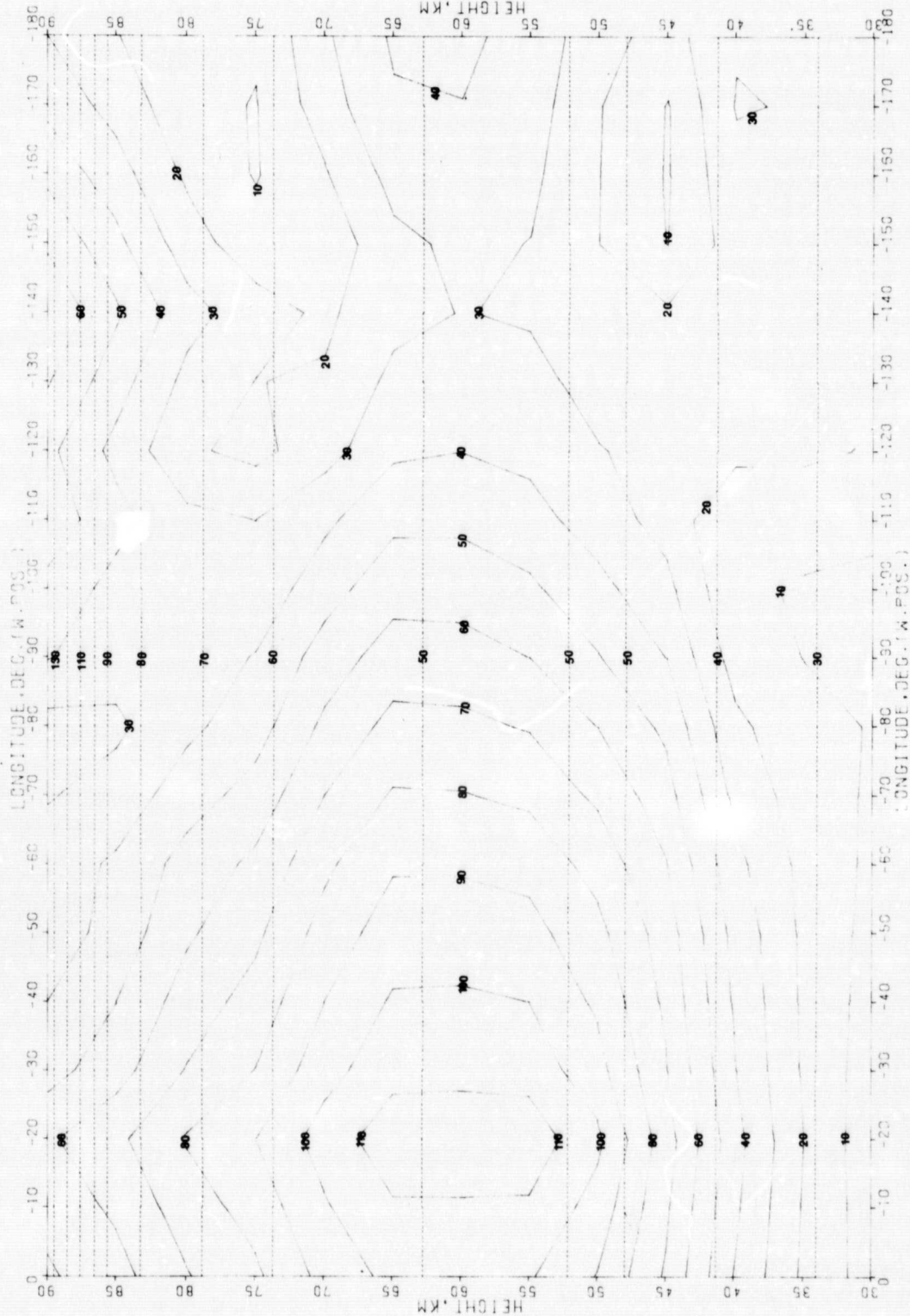
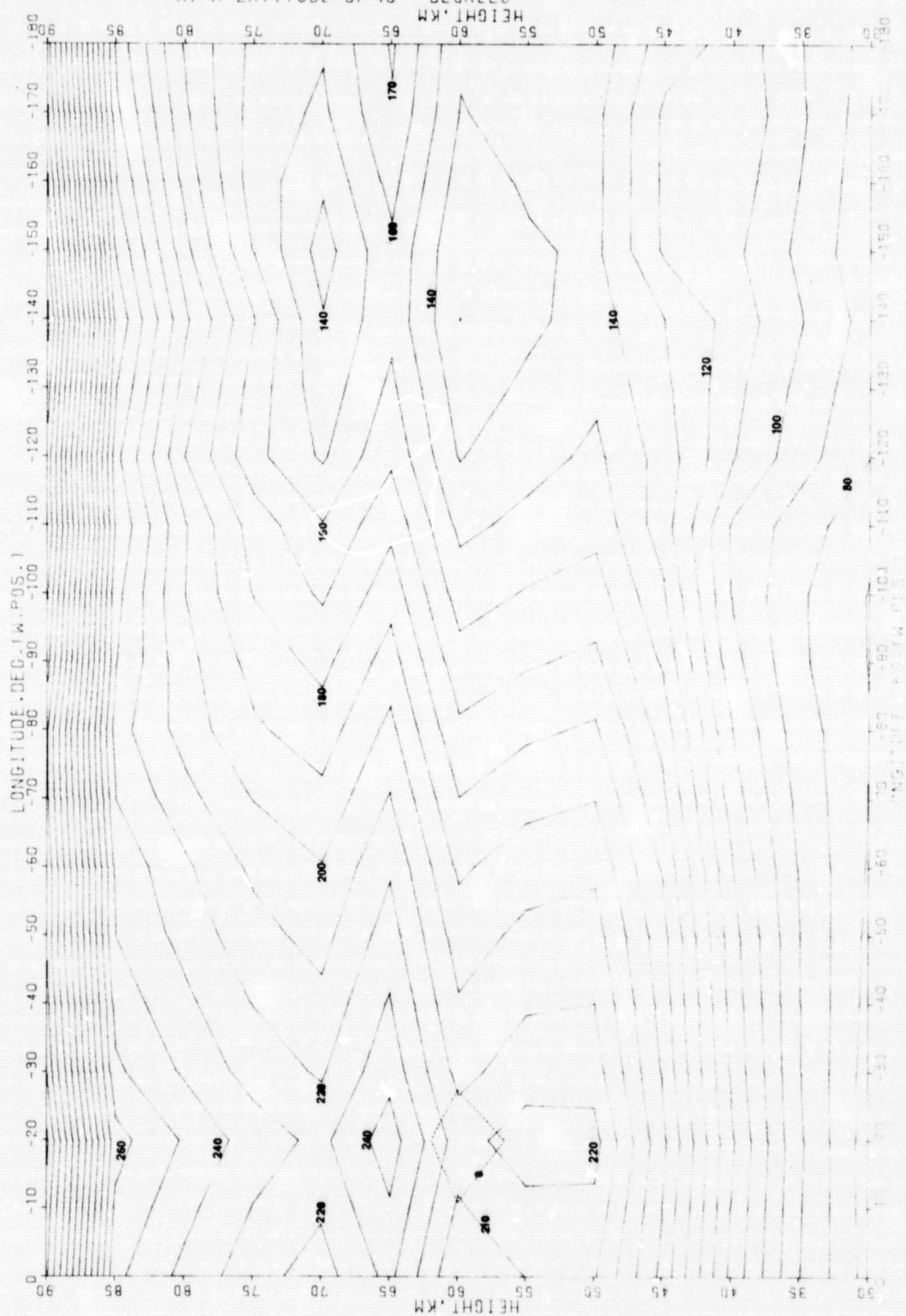


FIG 48

KEY -

— UPPER 99TH PERCENTILE OF WIND SPEED
 - - - - - LOWER 99TH PERCENTILE OF WIND SPEED
 DURING MONTH OF JANUARY
 AT A LATITUDE OF 45 DEGREES



KEY-

----- PRESSURE, PER CENT DEV. FROM STD. ATM.
 STD. DEV. OF PRESSURE
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

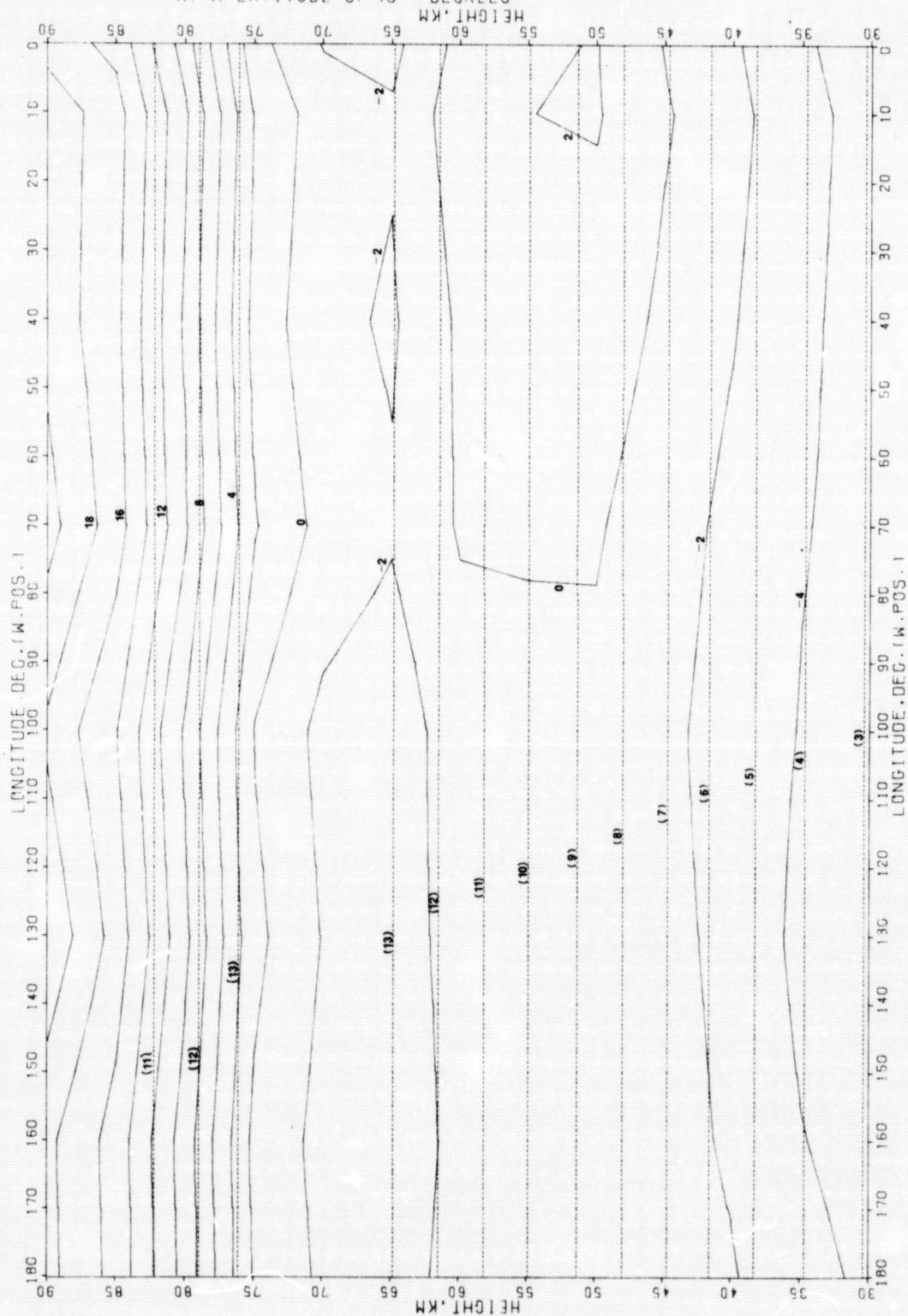


FIG 50

KEY-

—— UPPER 99TH PERCENTILE OF PRESSURE
 - - - - LOWER 99TH PERCENTILE OF PRESSURE
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

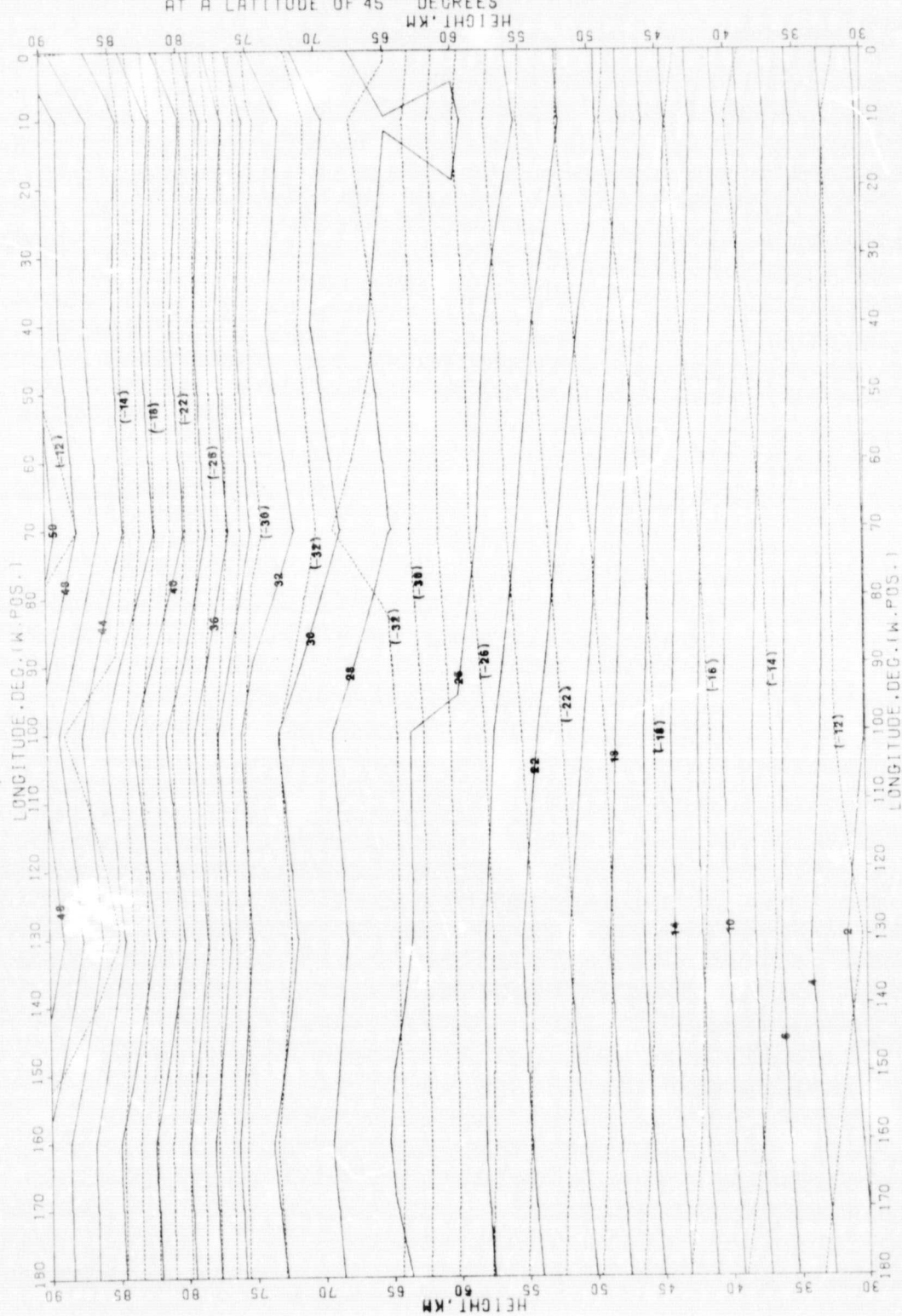


FIG 51

KEY-

— DENSITY, PER CENT DEV. FROM STD. ATM.
 --- STD. DEV. OF DENSITY
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

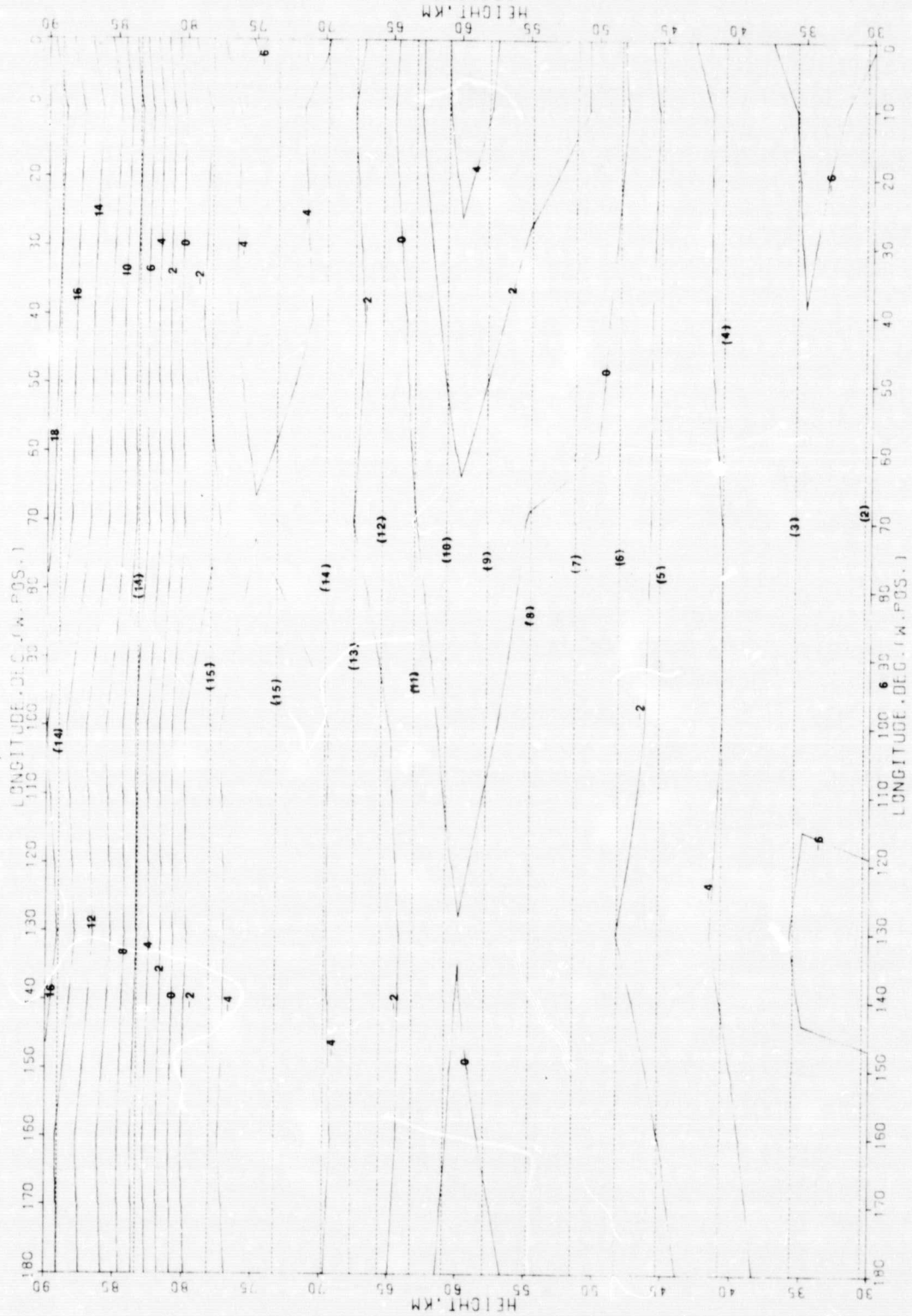


FIG 52

KEY-

— UPPER 99TH PERCENTILE OF DENSITY
 - - - LOWER 99TH PERCENTILE OF DENSITY
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

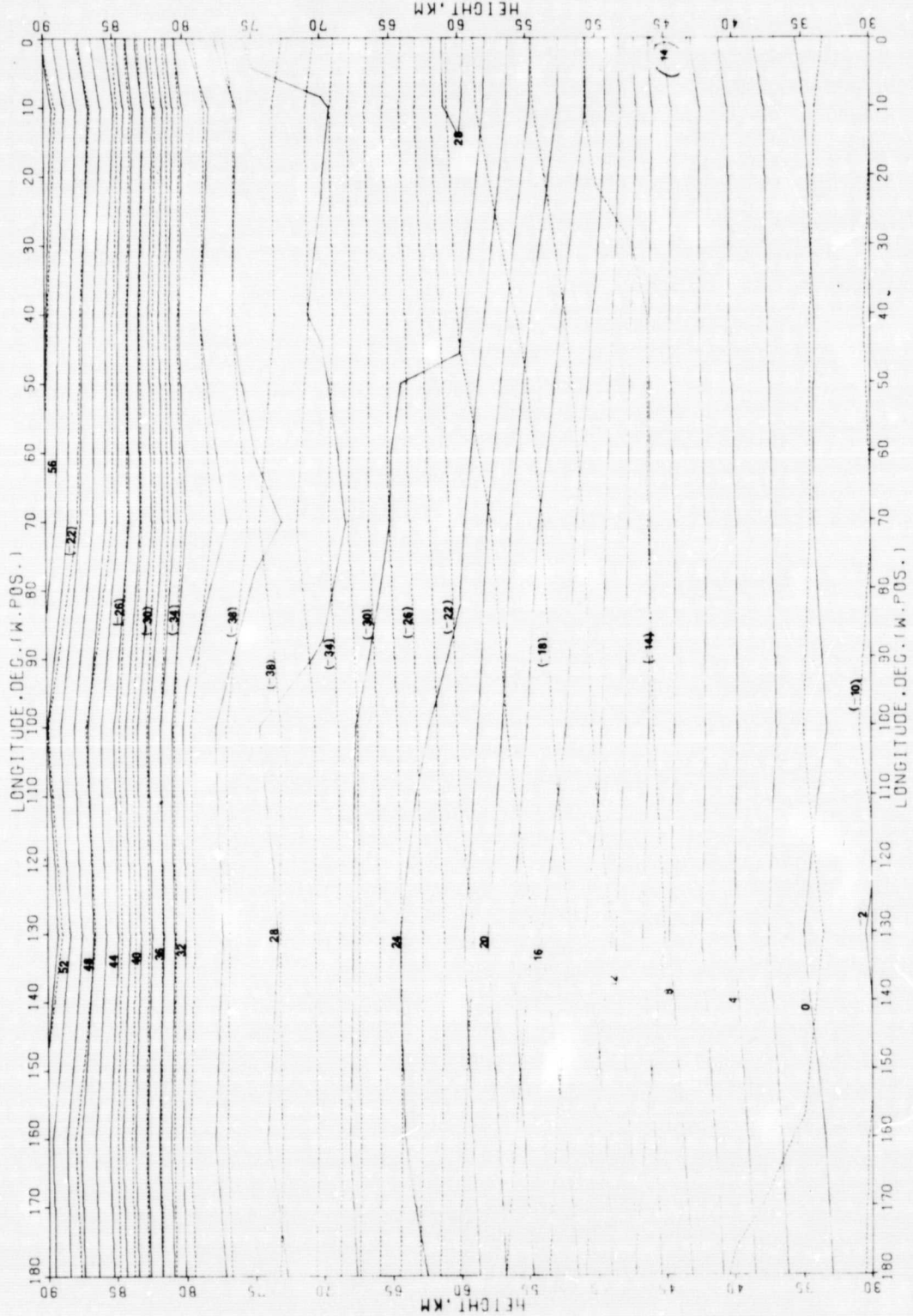
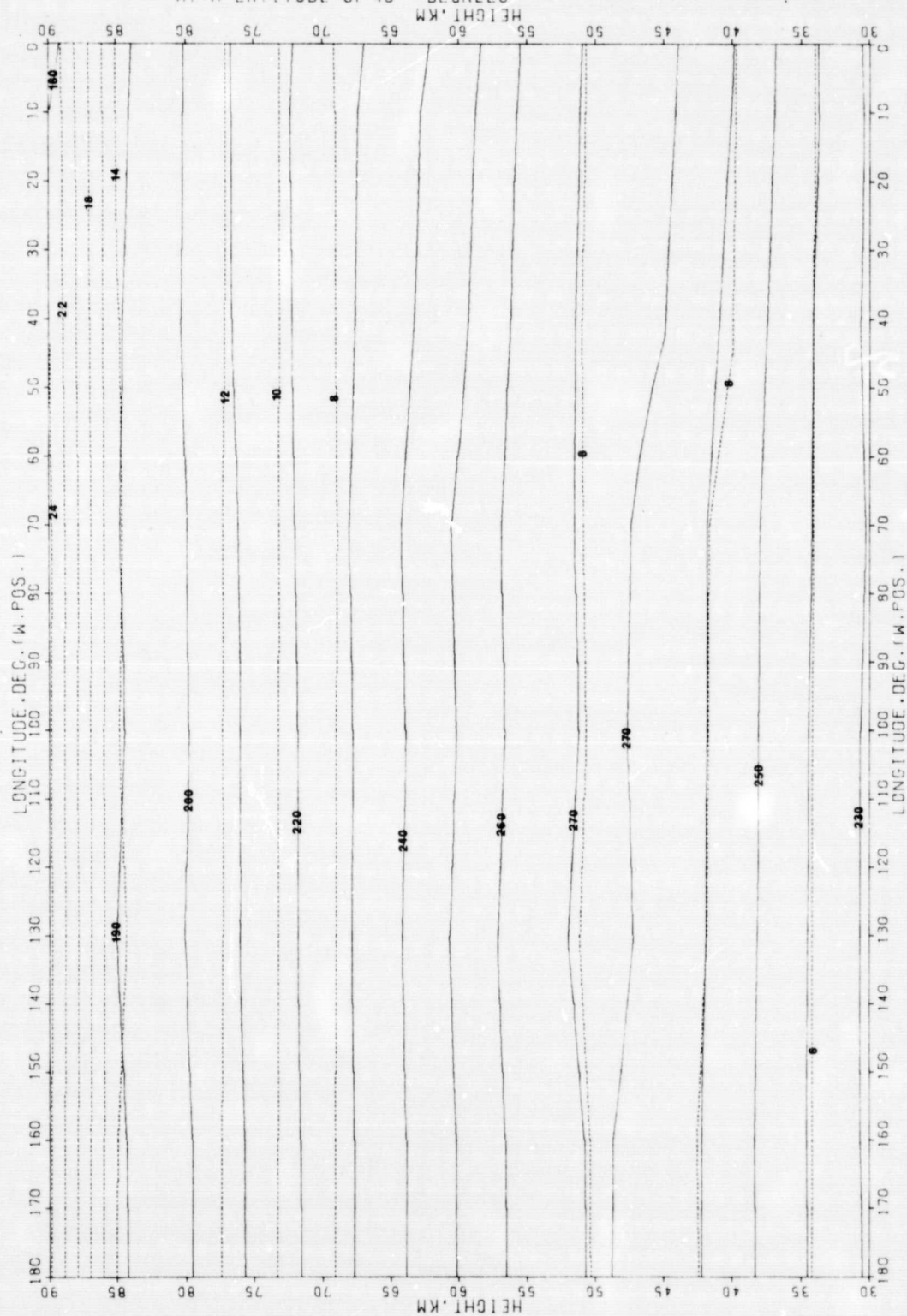


FIG 53

KEY-

—— TEMPERATURE, DEG. K
 STD. DEV. OF TEMPERATURE
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES



KEY-

DEGREES
WY' 14013H

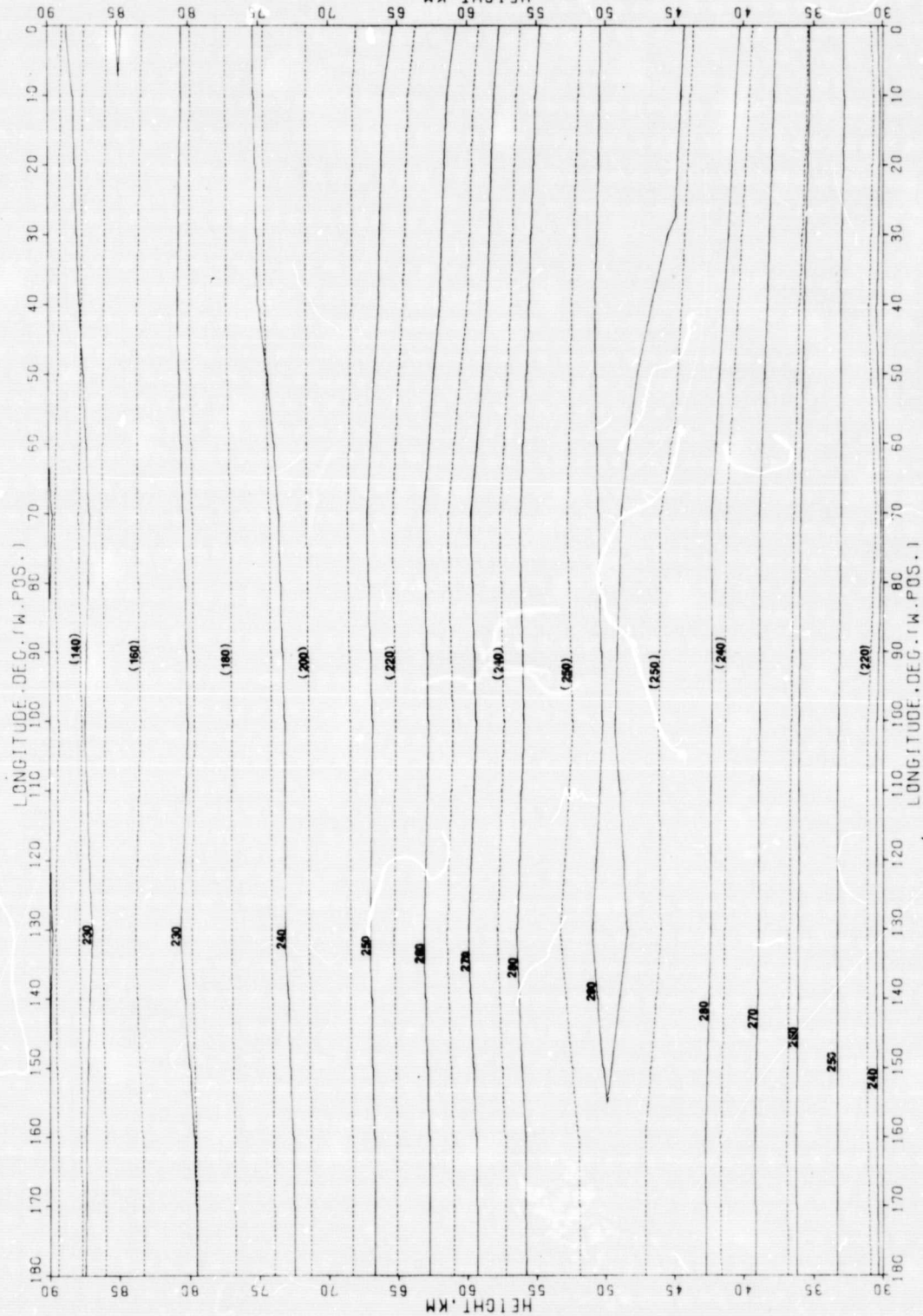


FIG 55

KEY-

— EASTWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - STD. DEV. OF EASTWARD WIND
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

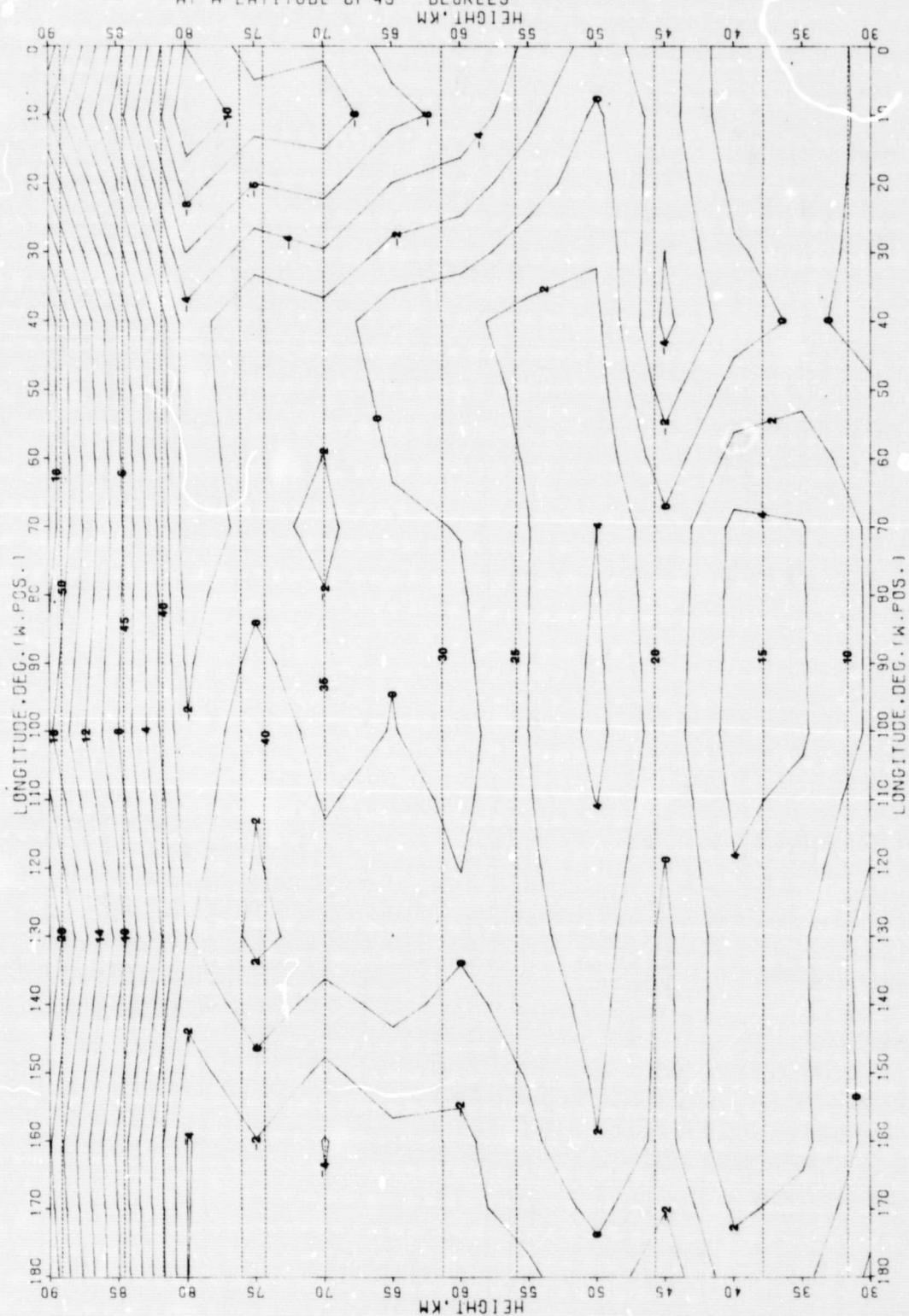


FIG 56

KEY-
 ——— UPPER 99TH PERCENTILE OF EASTWARD WIND
 - - - - - LOWER 99TH PERCENTILE OF EASTWARD WIND
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

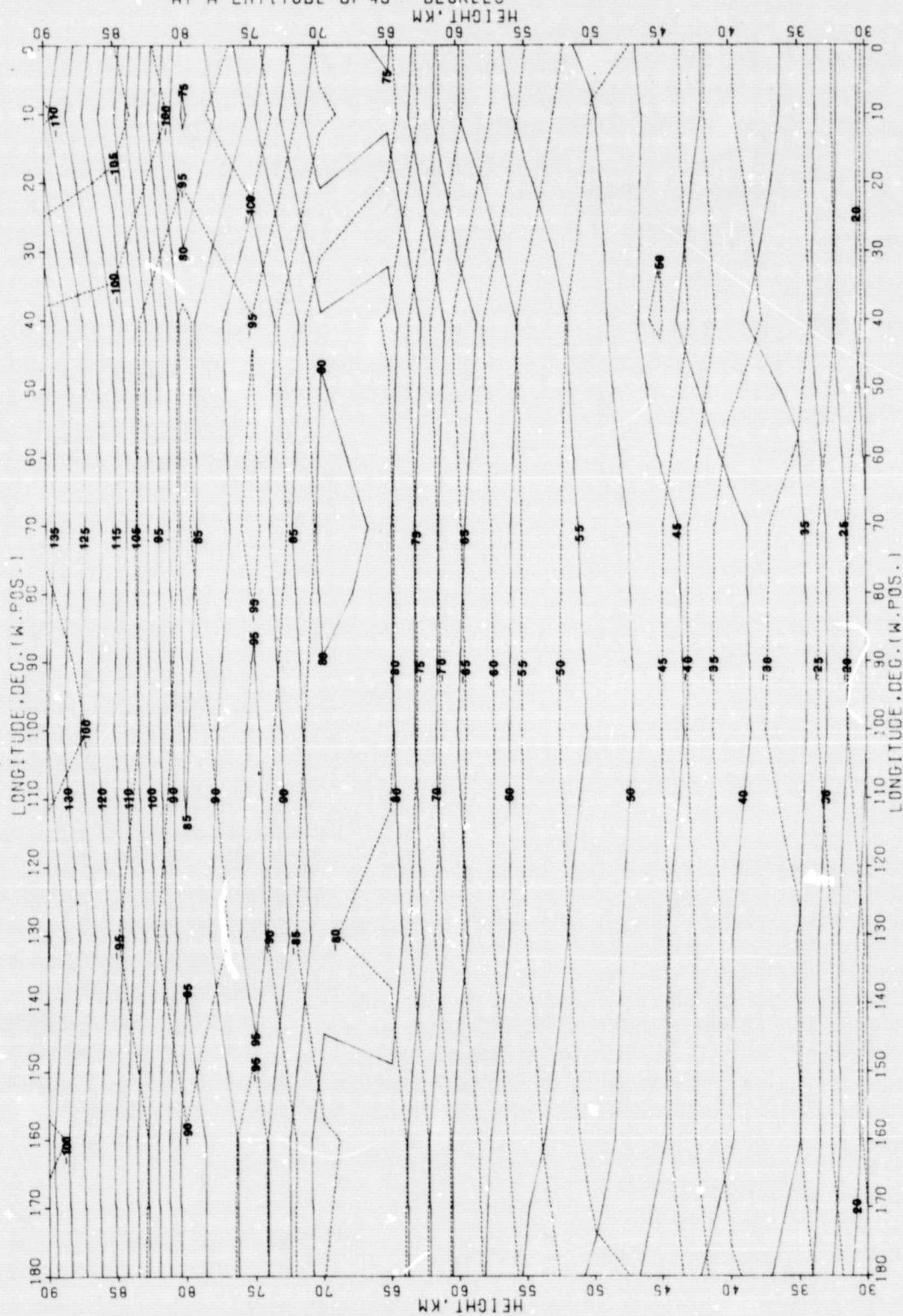


FIG 57

KEY-

--- NORTHWARD WIND, GEOSTROPHIC MONTHLY MEAN M/S
 - - - - - STD. DEV. OF NORTHWARD WIND
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

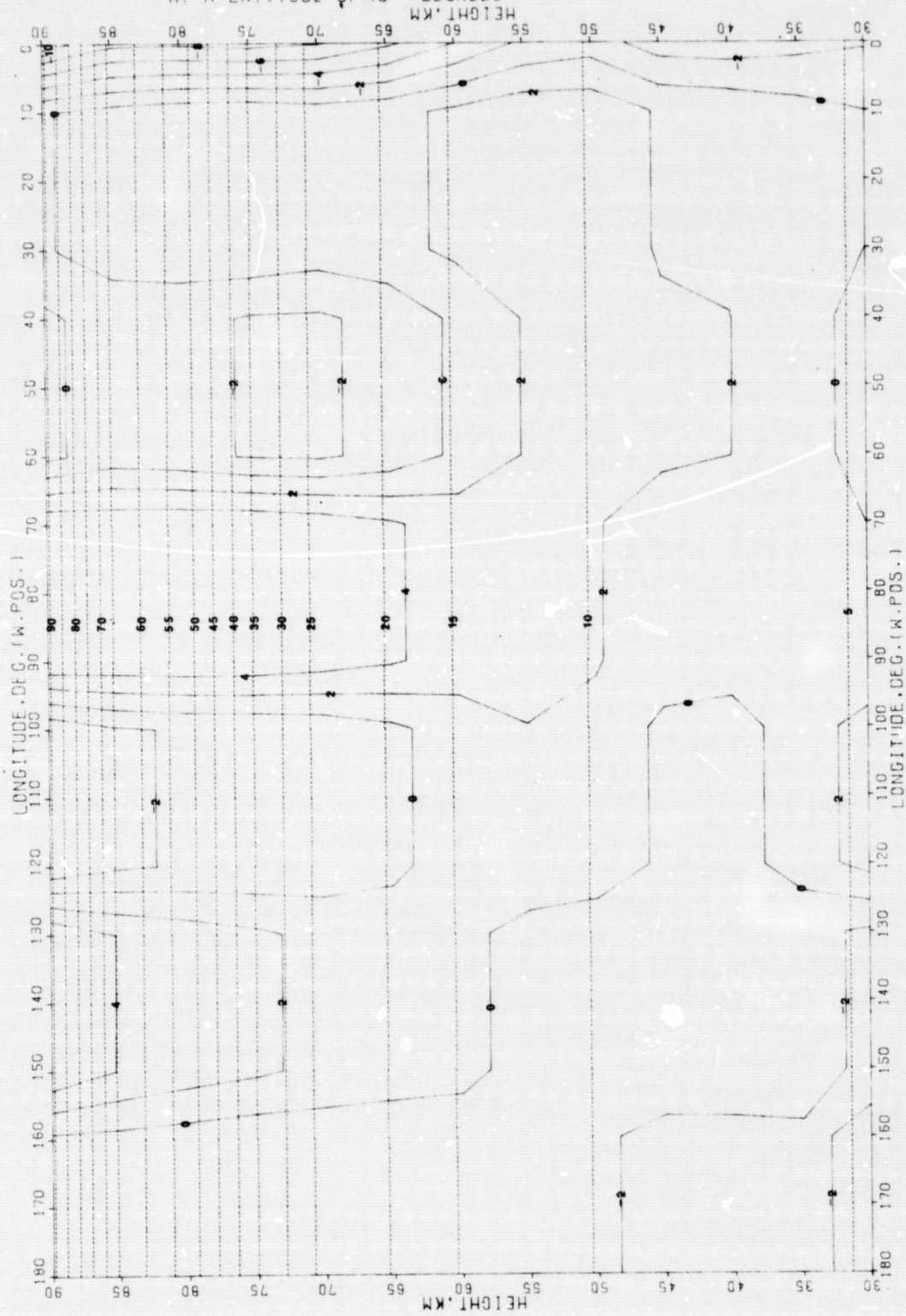


FIG 58

KEY-

— UPPER 99TH PERCENTILE OF NORTHWARD WIND
 LOWER 99TH PERCENTILE OF NORTHWARD WIND
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

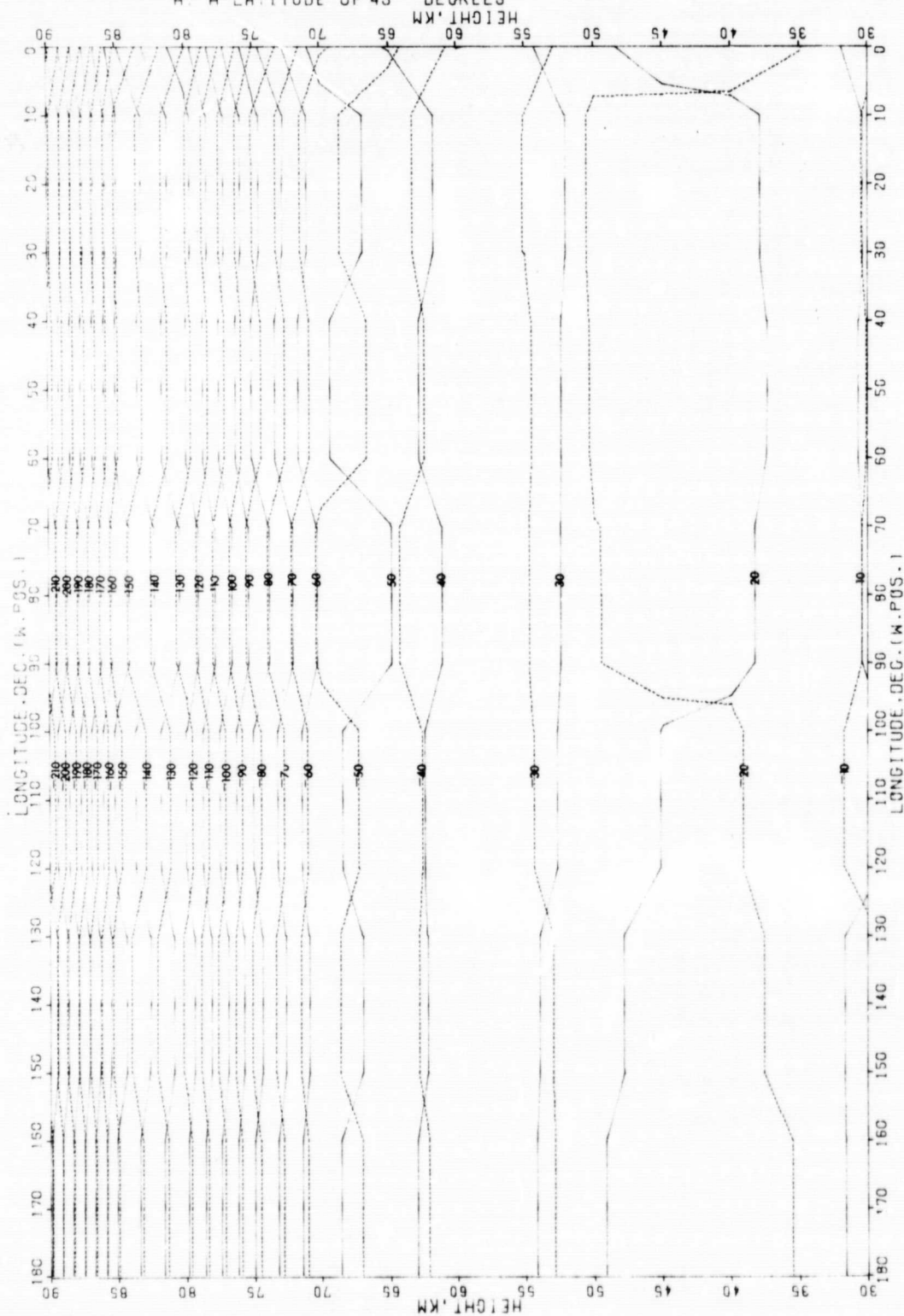


FIG 59

KEY-

— WIND SPEED M/S
 - - - - - STD. DEV. OF WIND SPEED
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

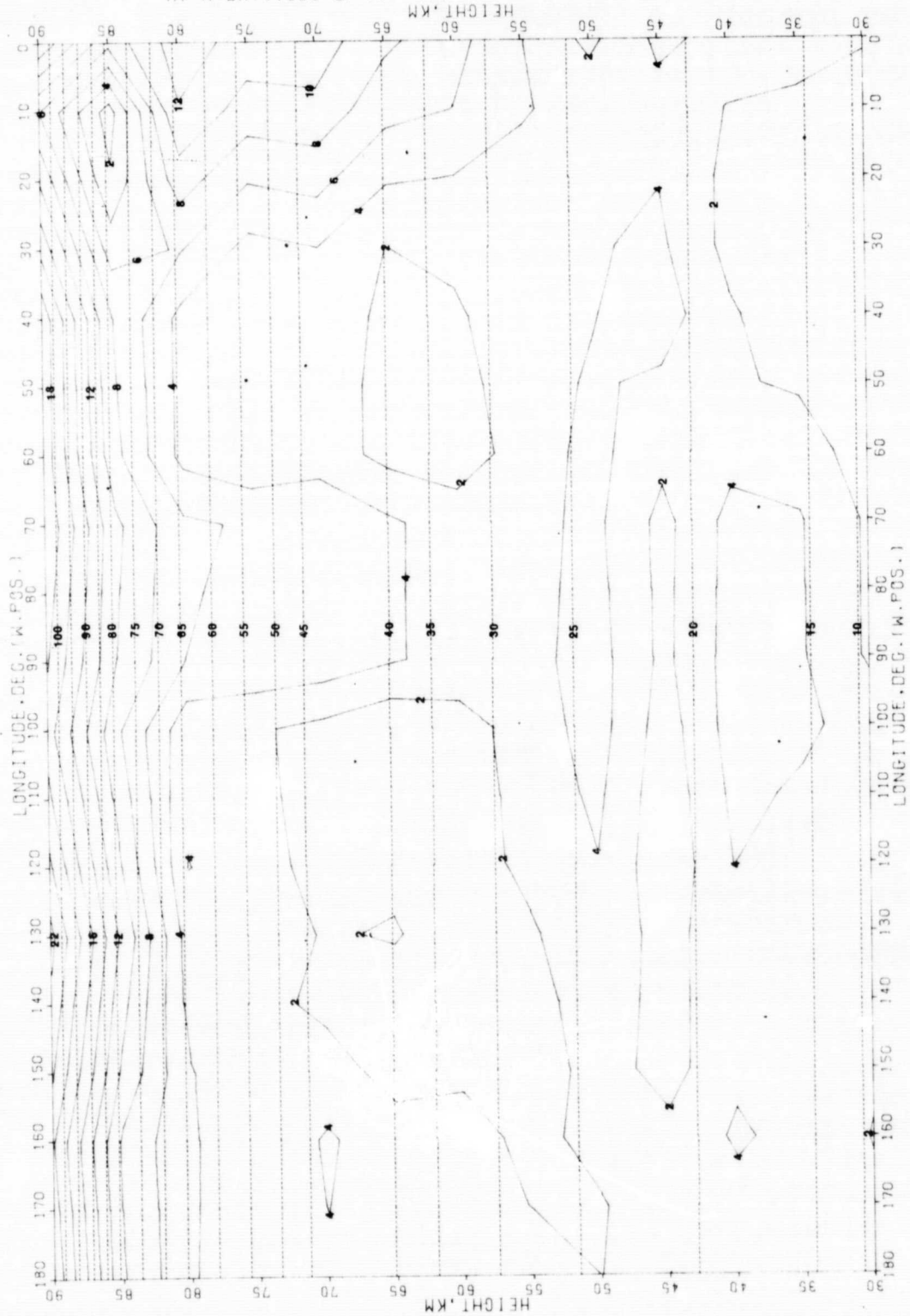


FIG 60

KEY-

—— UPPER 99TH PERCENTILE OF WIND SPEED
 - - - - LOWER 99TH PERCENTILE OF WIND SPEED
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

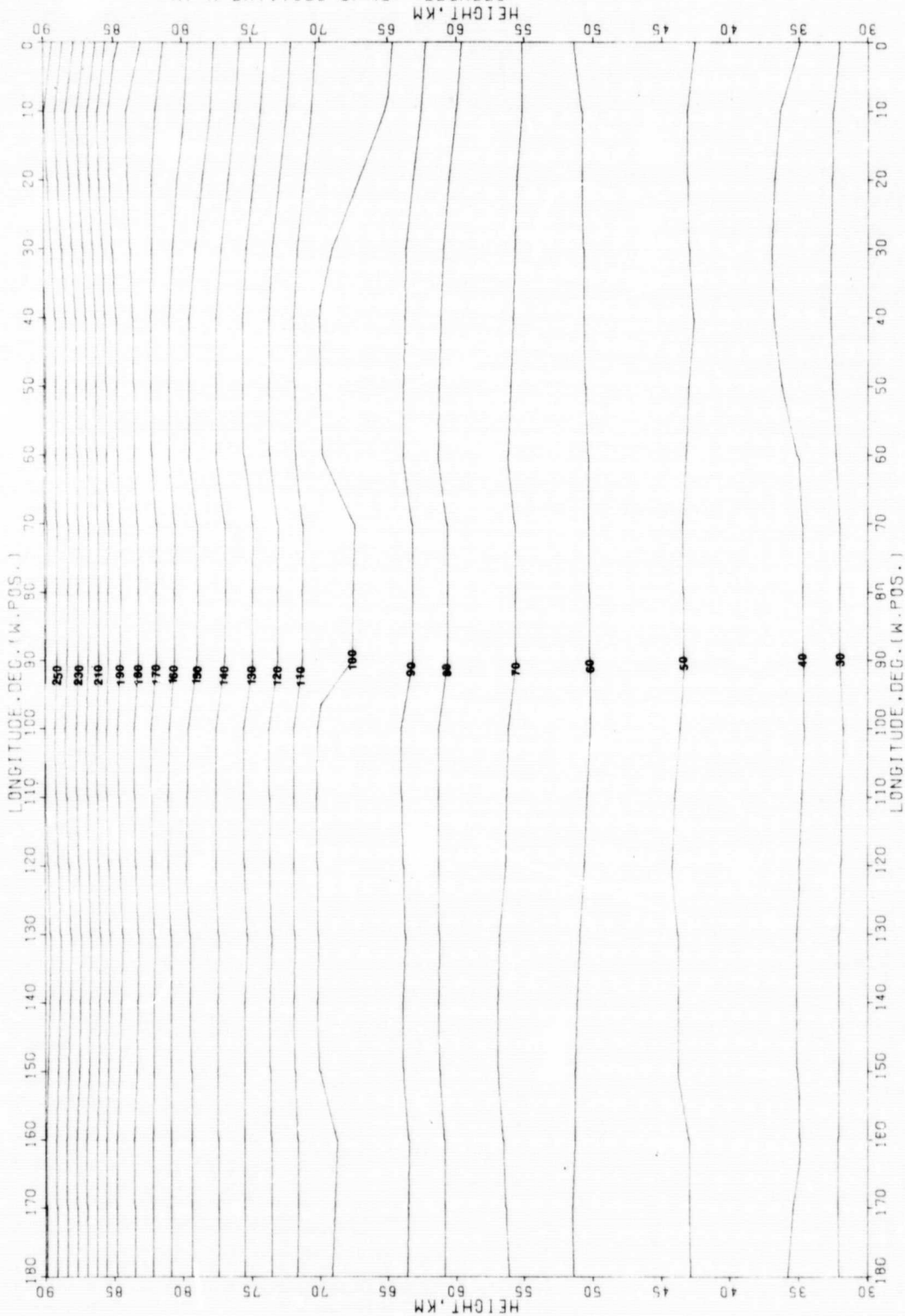


FIG 61

KEY-

— PRESSURE, PER CENT DEV. FROM STD. ATM.
 - - - - - STD. DEV. OF PRESSURE
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

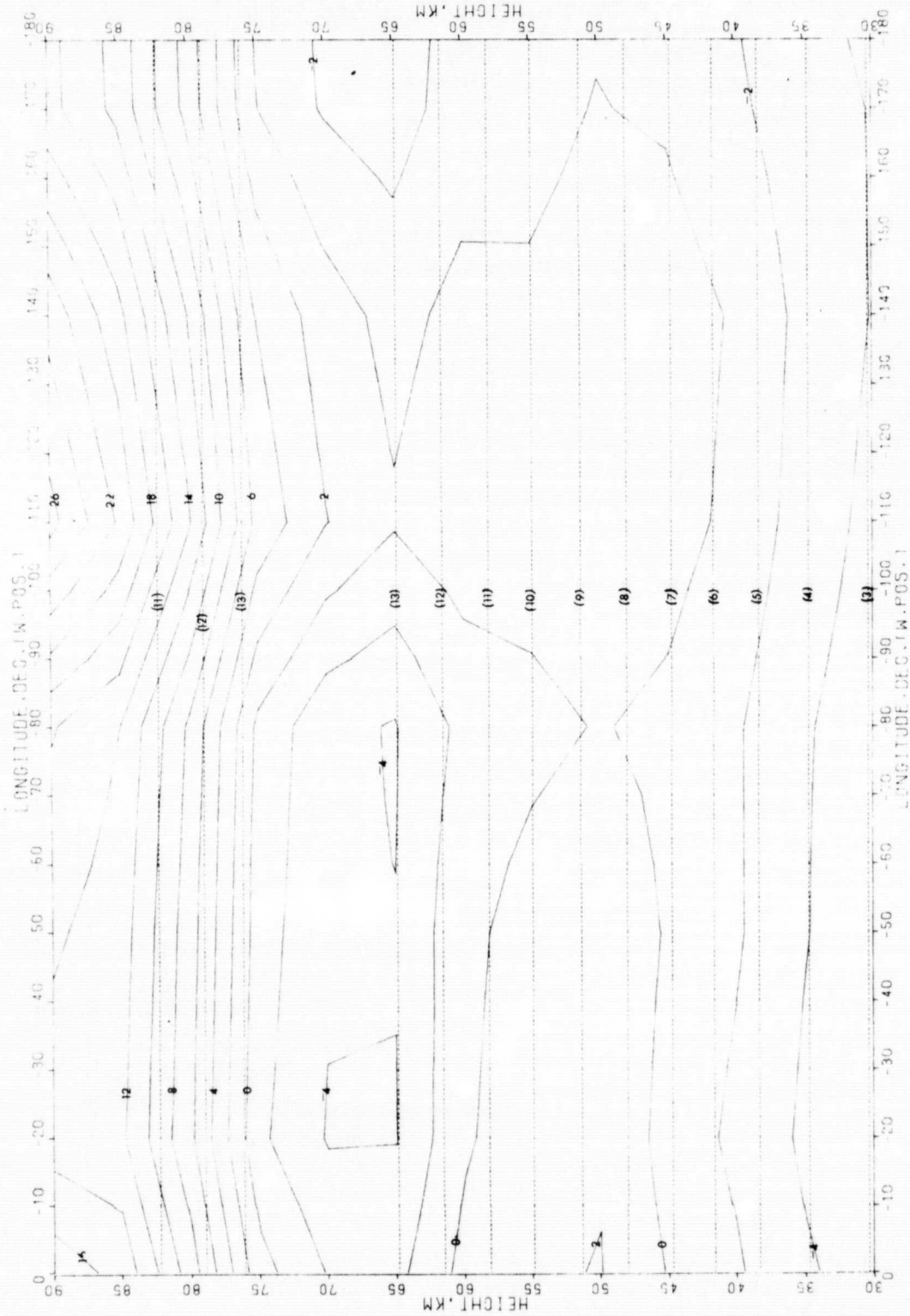


FIG 62

KEY-

—— UPPER 99TH PERCENTILE OF PRESSURE
 LOWER 99TH PERCENTILE OF PRESSURE
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

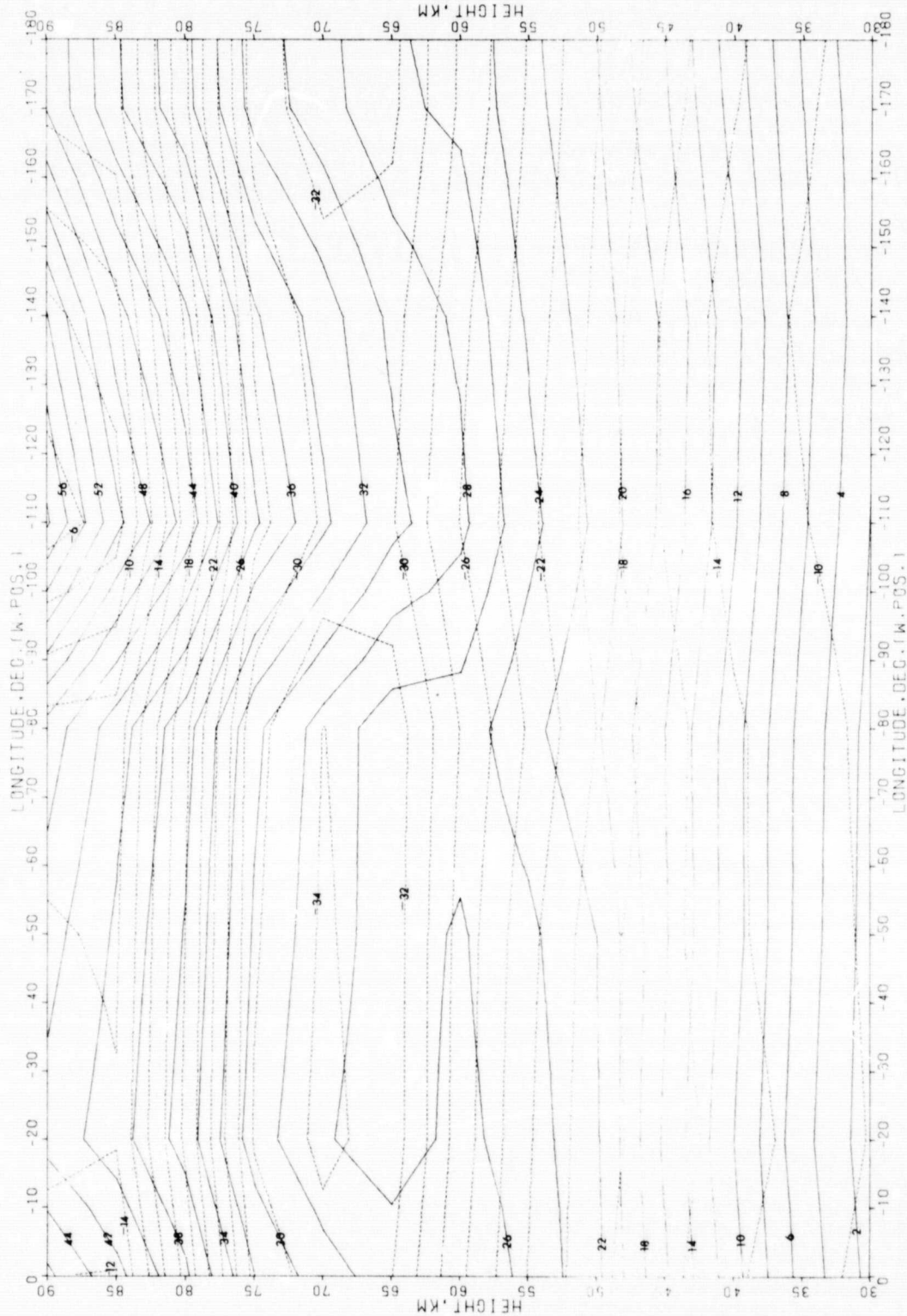


FIG 63

KEY-

— DENSITY, PER CENT DEV. FROM STD. ATM.
 - - - STD. DEV. OF DENSITY
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

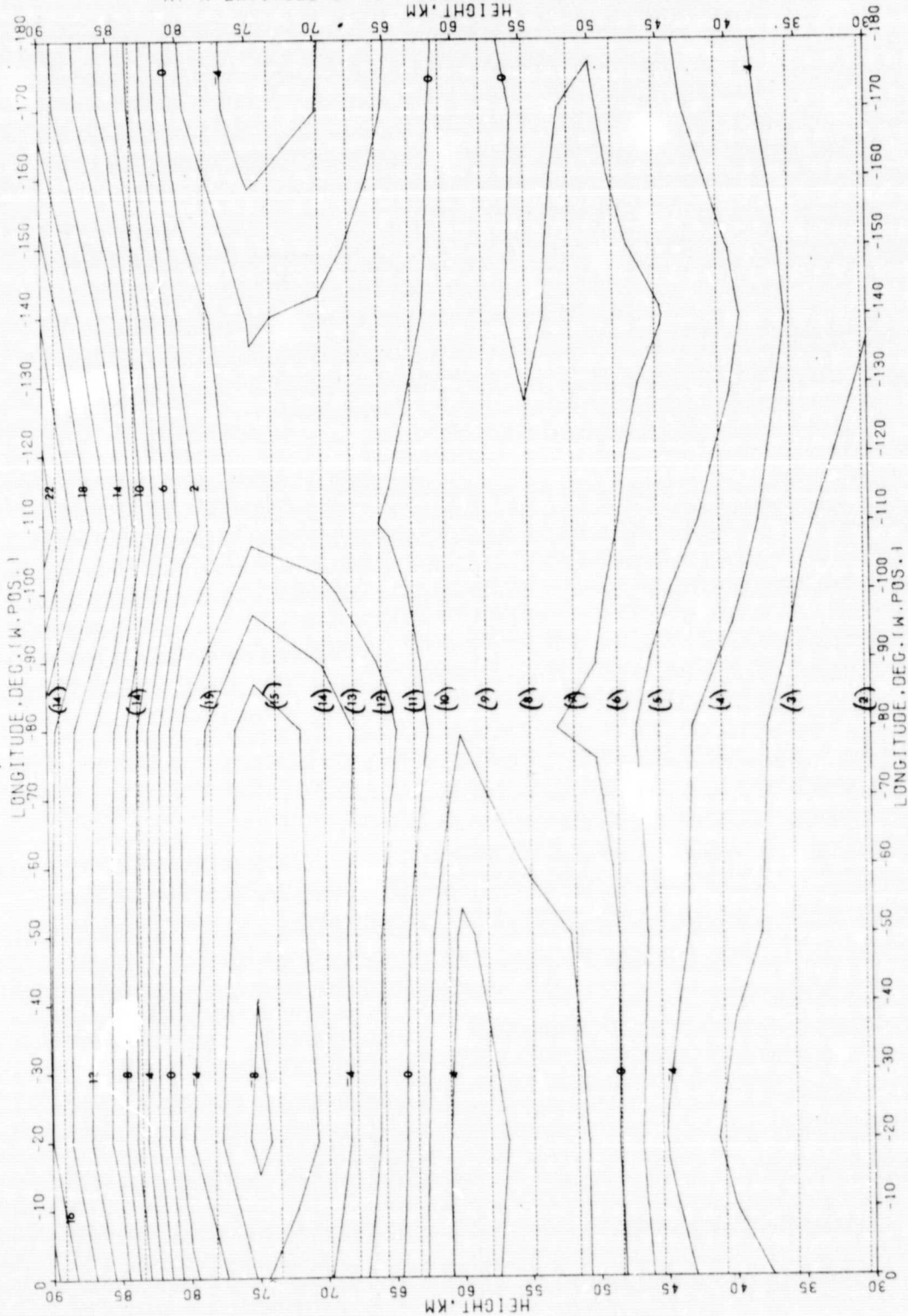


FIG 64

KEY-

—— UPPER 99TH PERCENTILE OF DENSITY
 LOWER 99TH PERCENTILE OF DENSITY
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

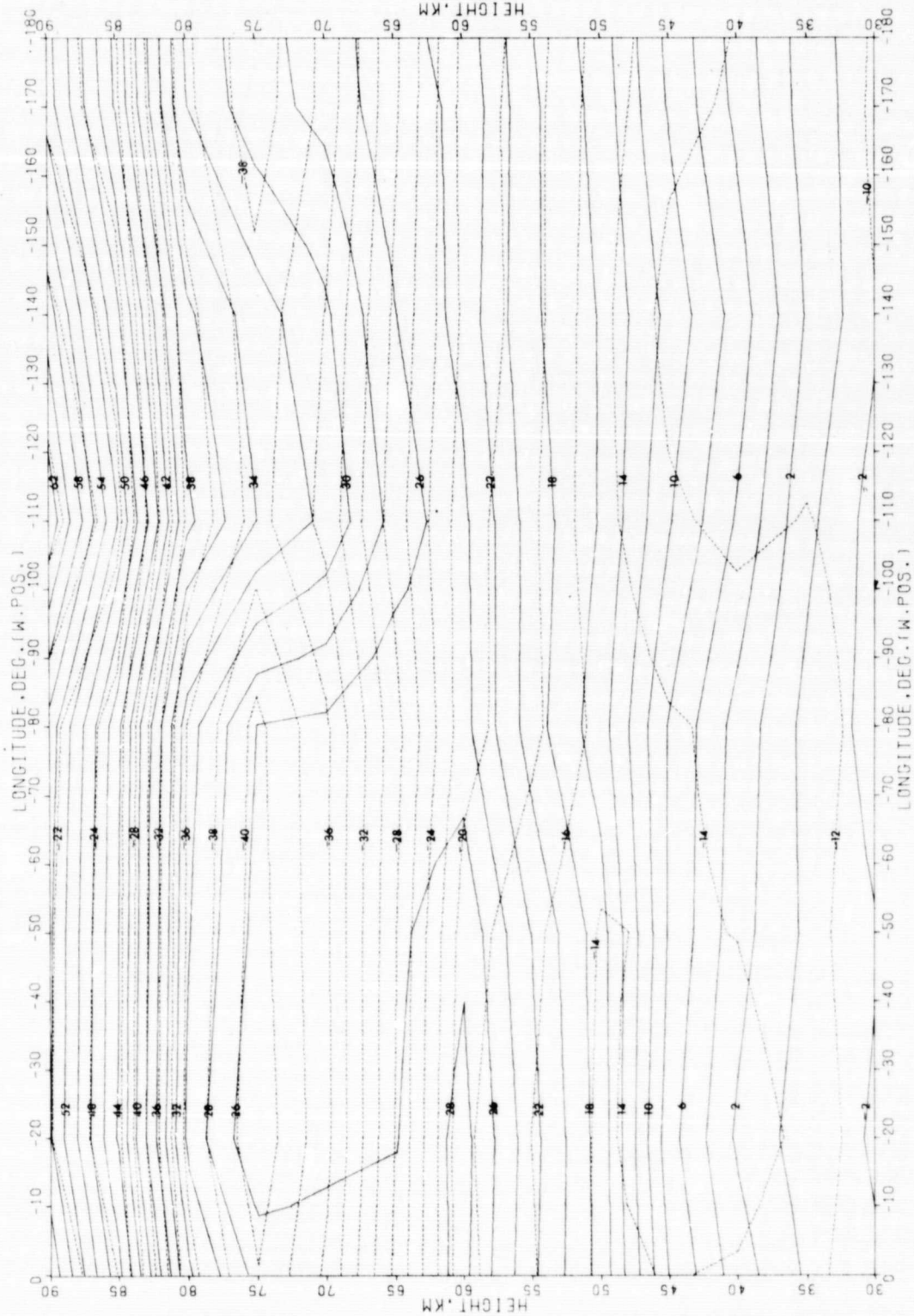
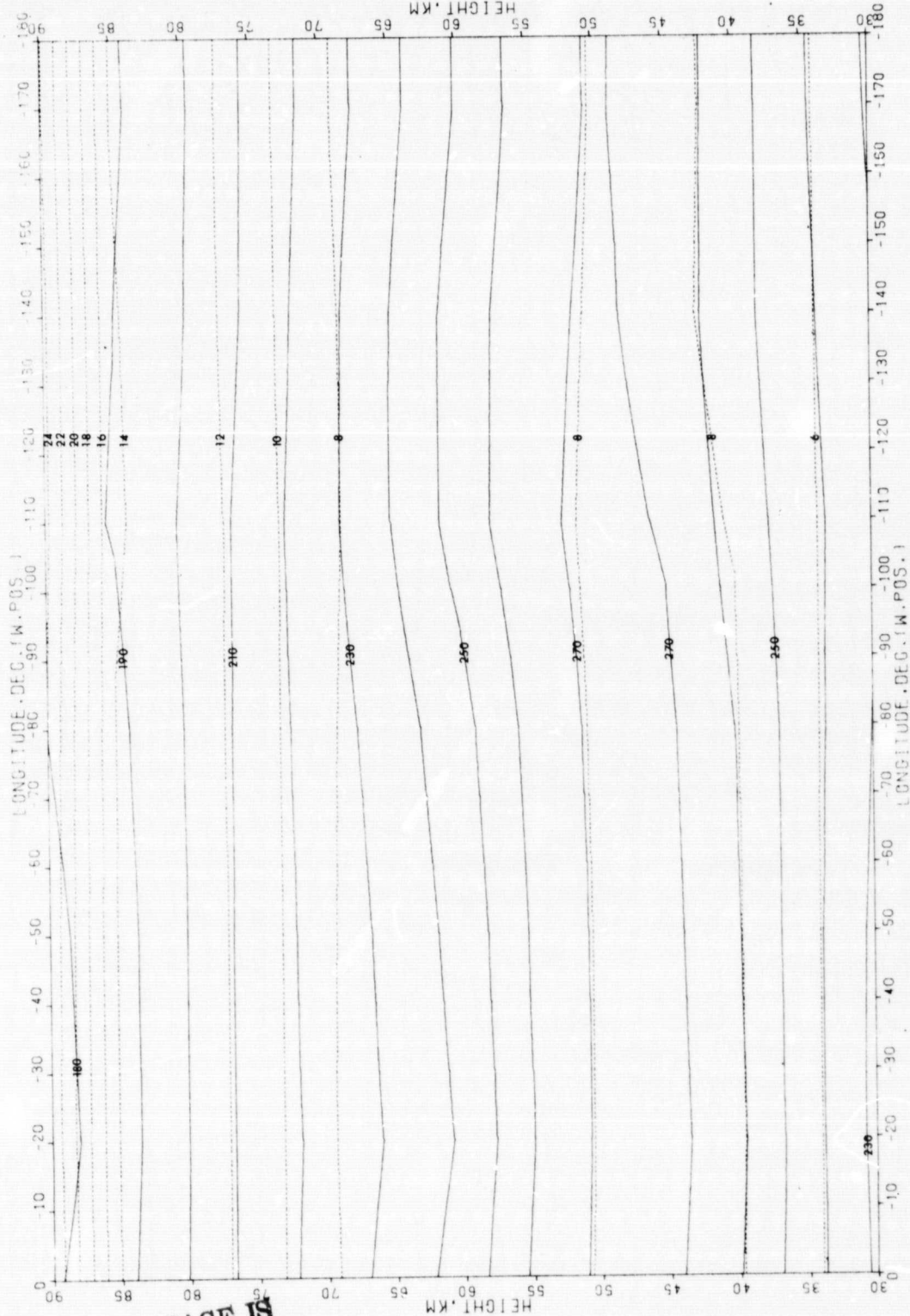


FIG 65

KEY-

— TEMPERATURE, DEG. K
 - - - STD. DEV. OF TEMPERATURE
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES



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FIG 66

KEY-

—— UPPER 99TH PERCENTILE OF TEMPERATURE
 - - - - LOWER 99TH PERCENTILE OF TEMPERATURE
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

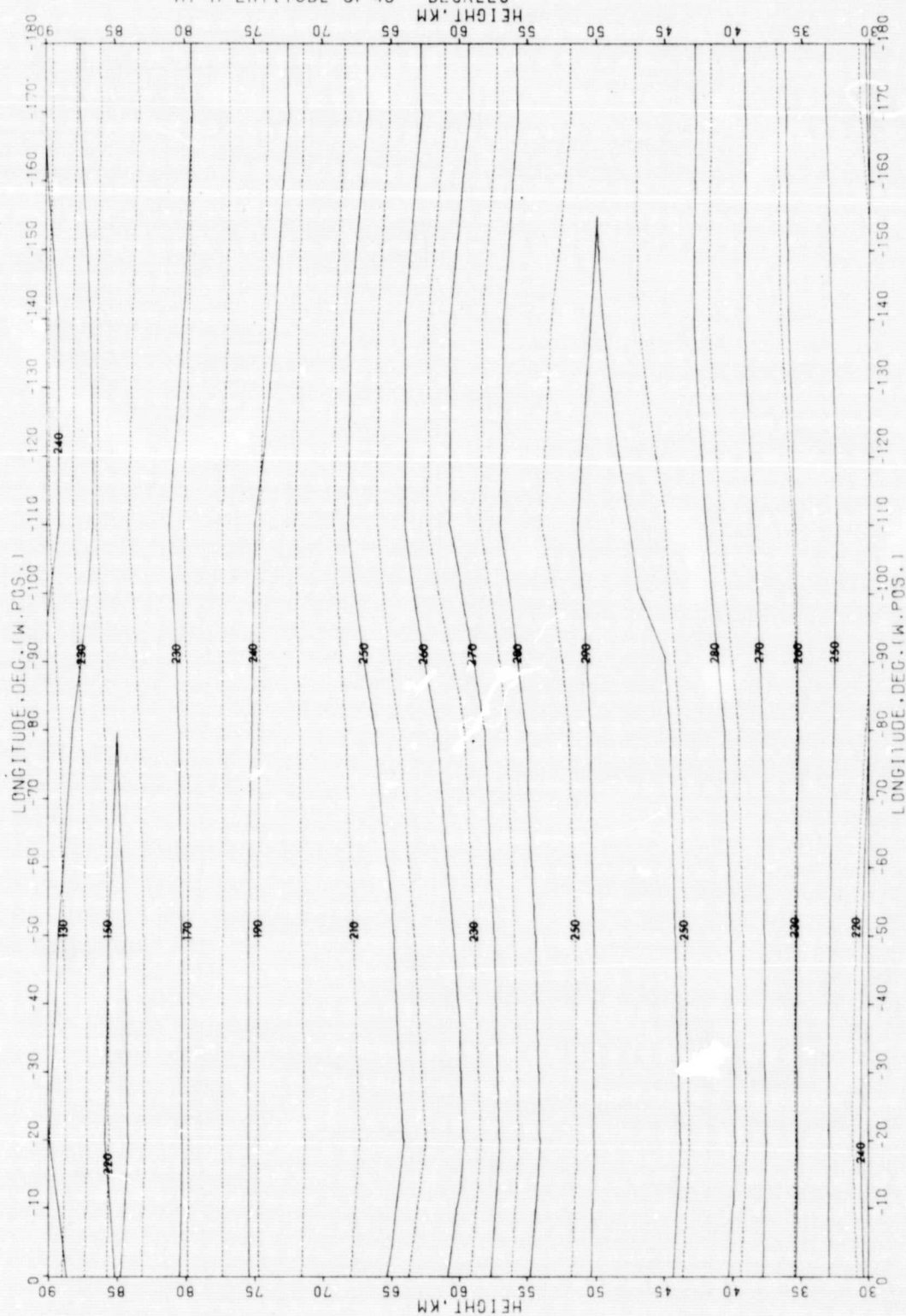


FIG 67

KEY-

— EASTWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - - - STD. DEV. OF EASTWARD WIND
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

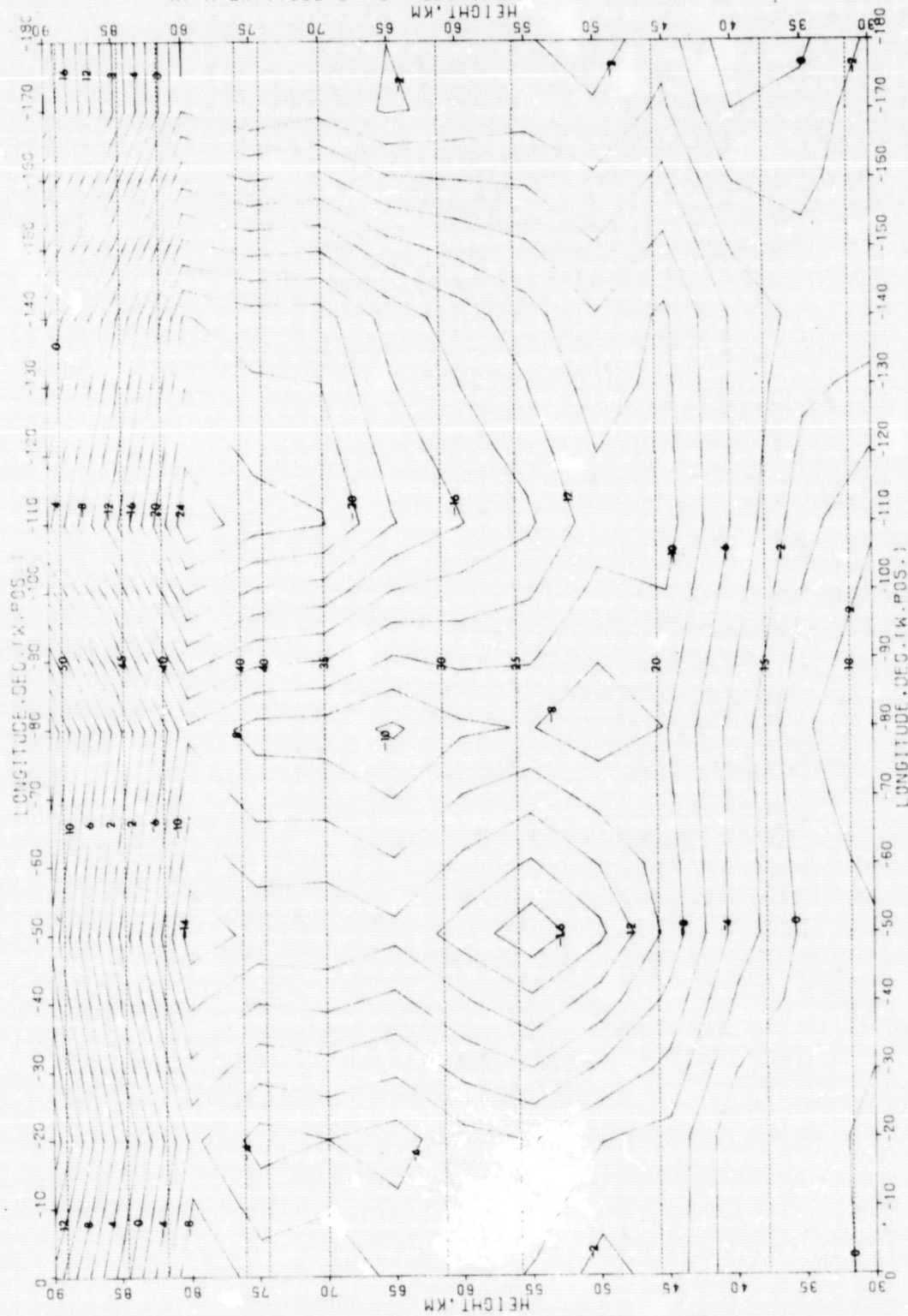
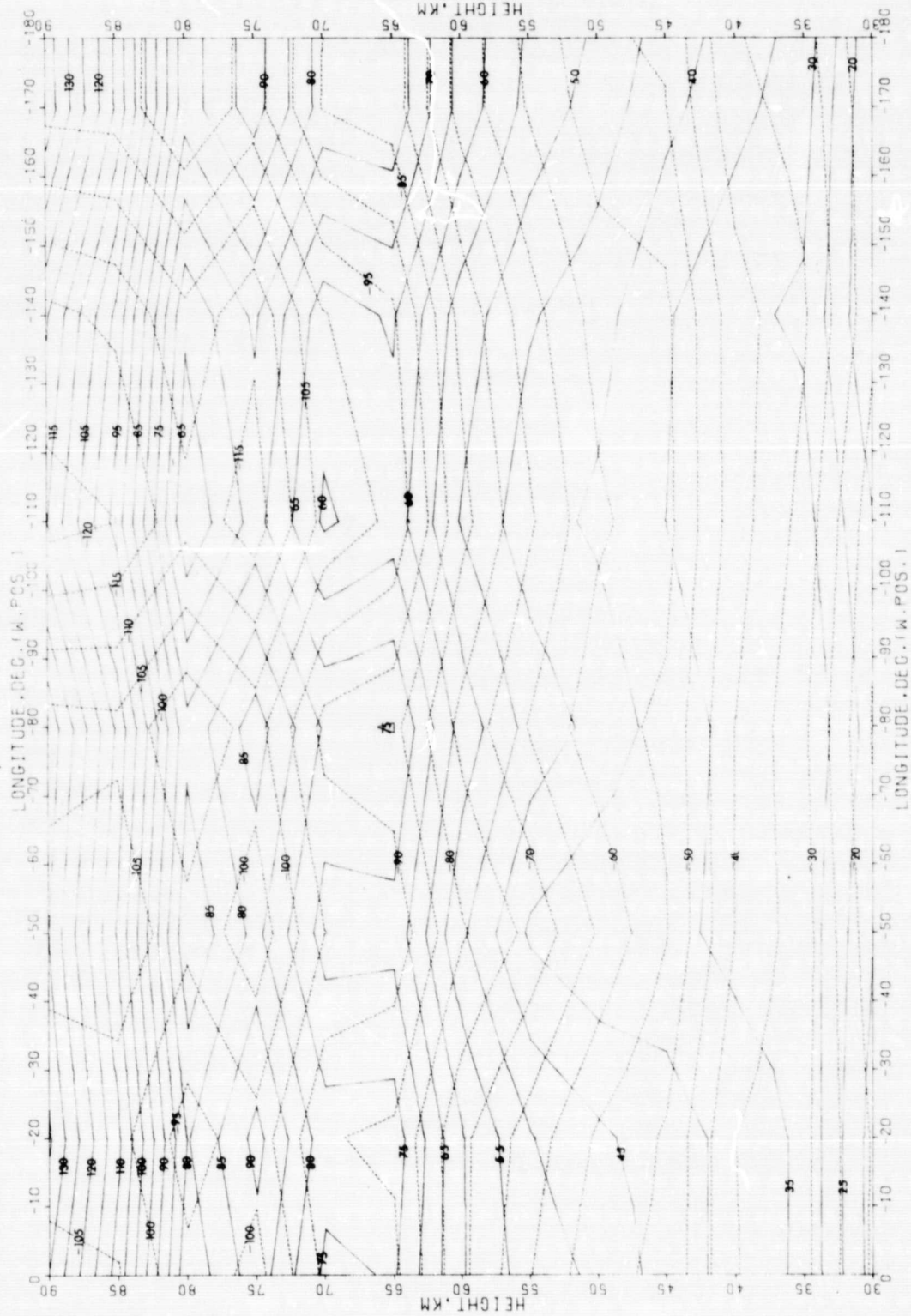


FIG 68

KEY-

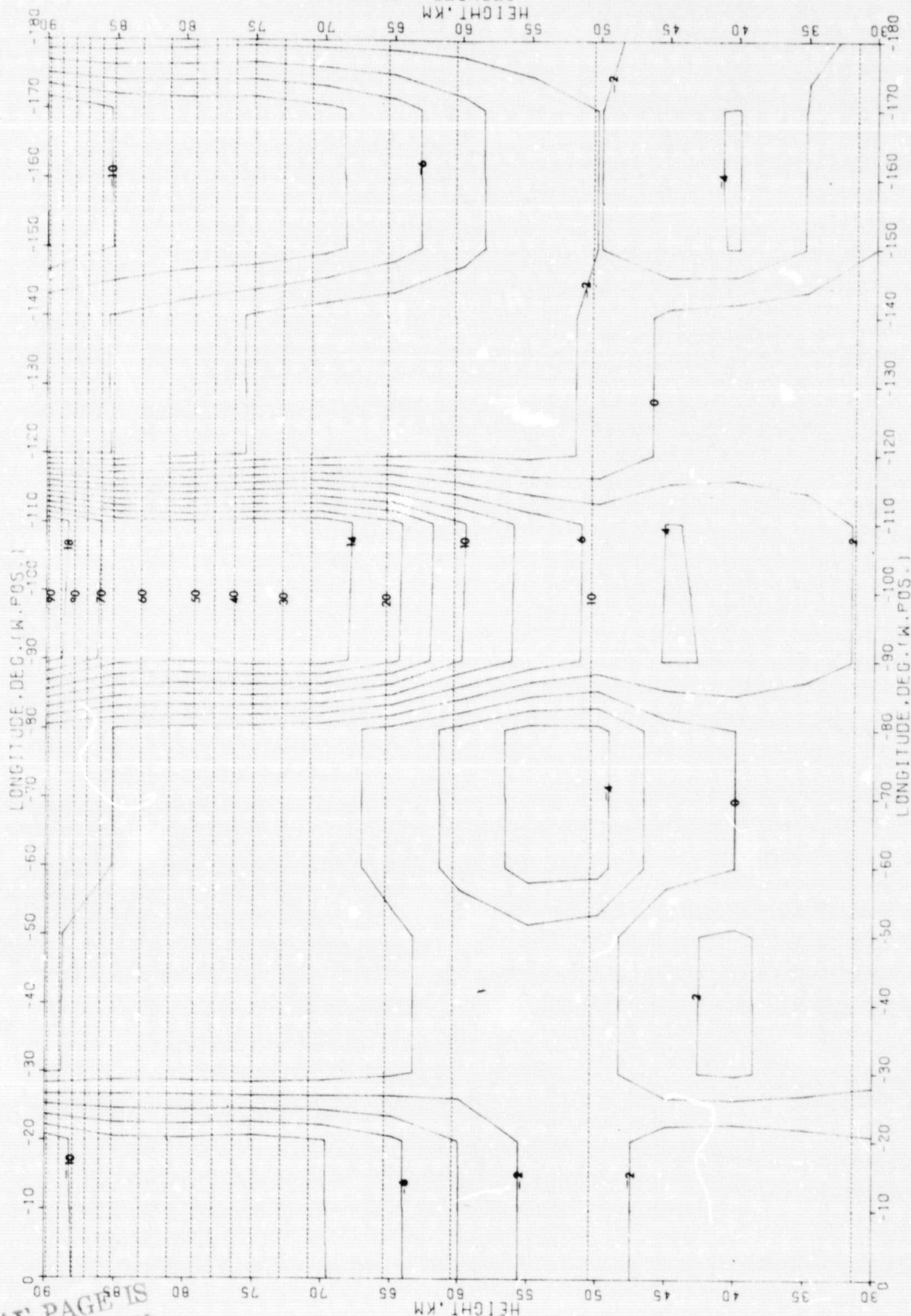
—— UPPER 99TH PERCENTILE OF EASTWARD WIND
 LOWER 99TH PERCENTILE OF EASTWARD WIND
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES



KEY-

FIG 69

— NORTHWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - - - STD. DEV. OF NORTHWARD WIND
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES



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FIG 70

KEY-

—— UPPER 99TH PERCENTILE OF NORTHWARD WIND
 LOWER 99TH PERCENTILE OF NORTHWARD WIND
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES

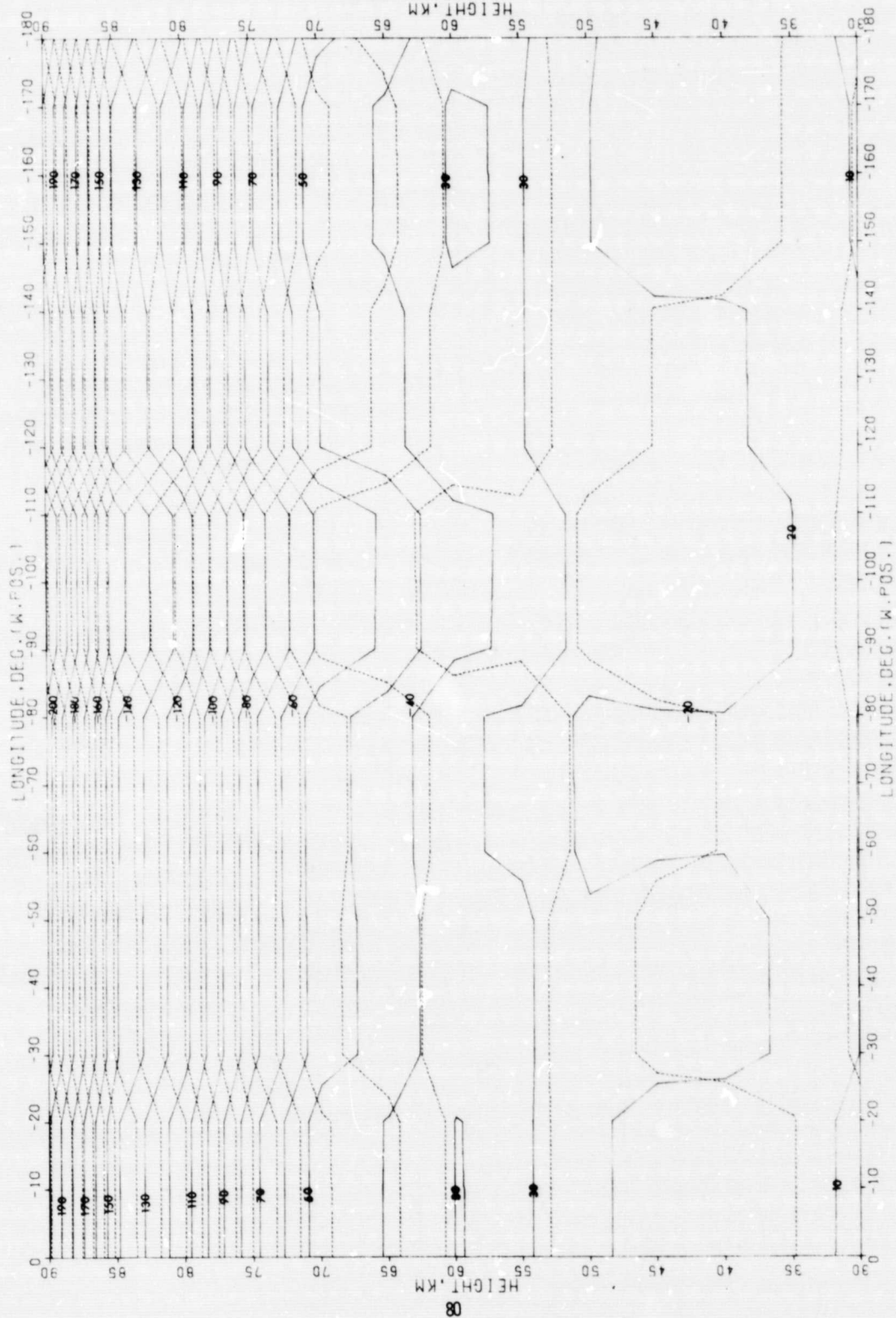
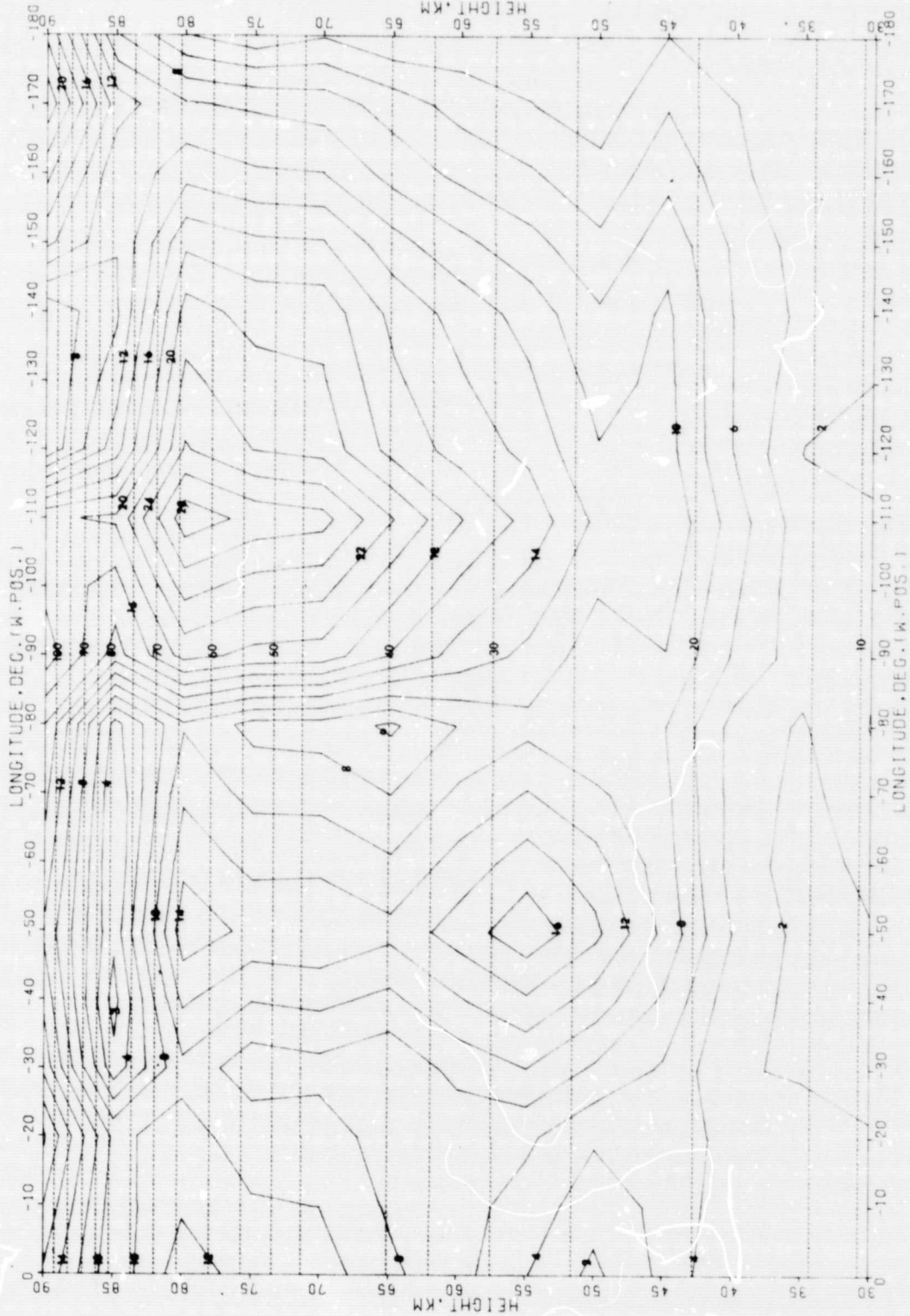


FIG 71

KEY-

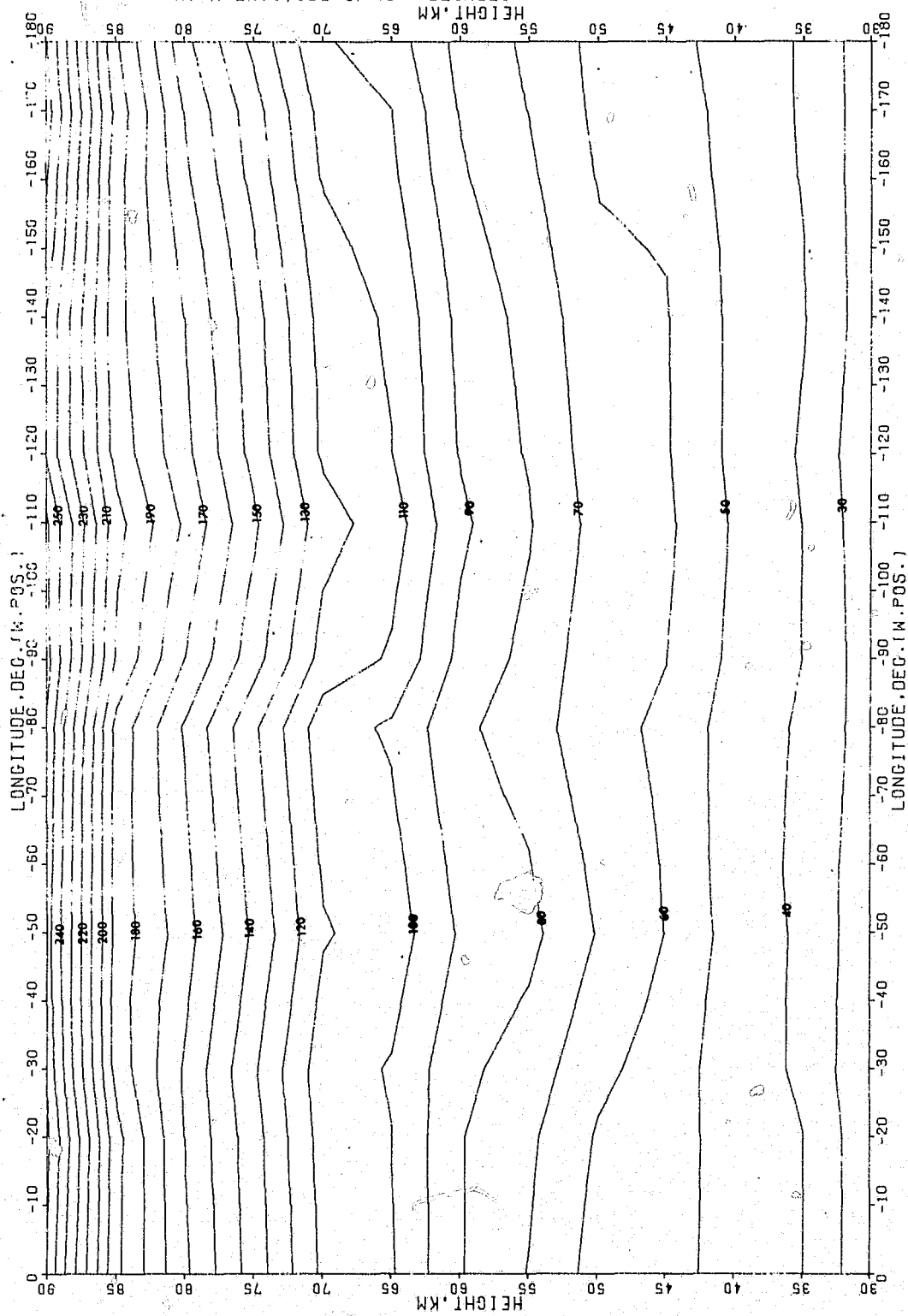
—— WIND SPEED M/S
 - - - - - STD. DEV. OF WIND SPEED
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES



KEY-

FIG 72

—— UPPER 99TH PERCENTILE OF WIND SPEED
 - - - - - LOWER 99TH PERCENTILE OF WIND SPEED
 DURING MONTH OF APRIL
 AT A LATITUDE OF 45 DEGREES



KEY-

FIG 73

----- PRESSURE, PER CENT DEV. FROM STD. ATM.
 STD. DEV. OF PRESSURE
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

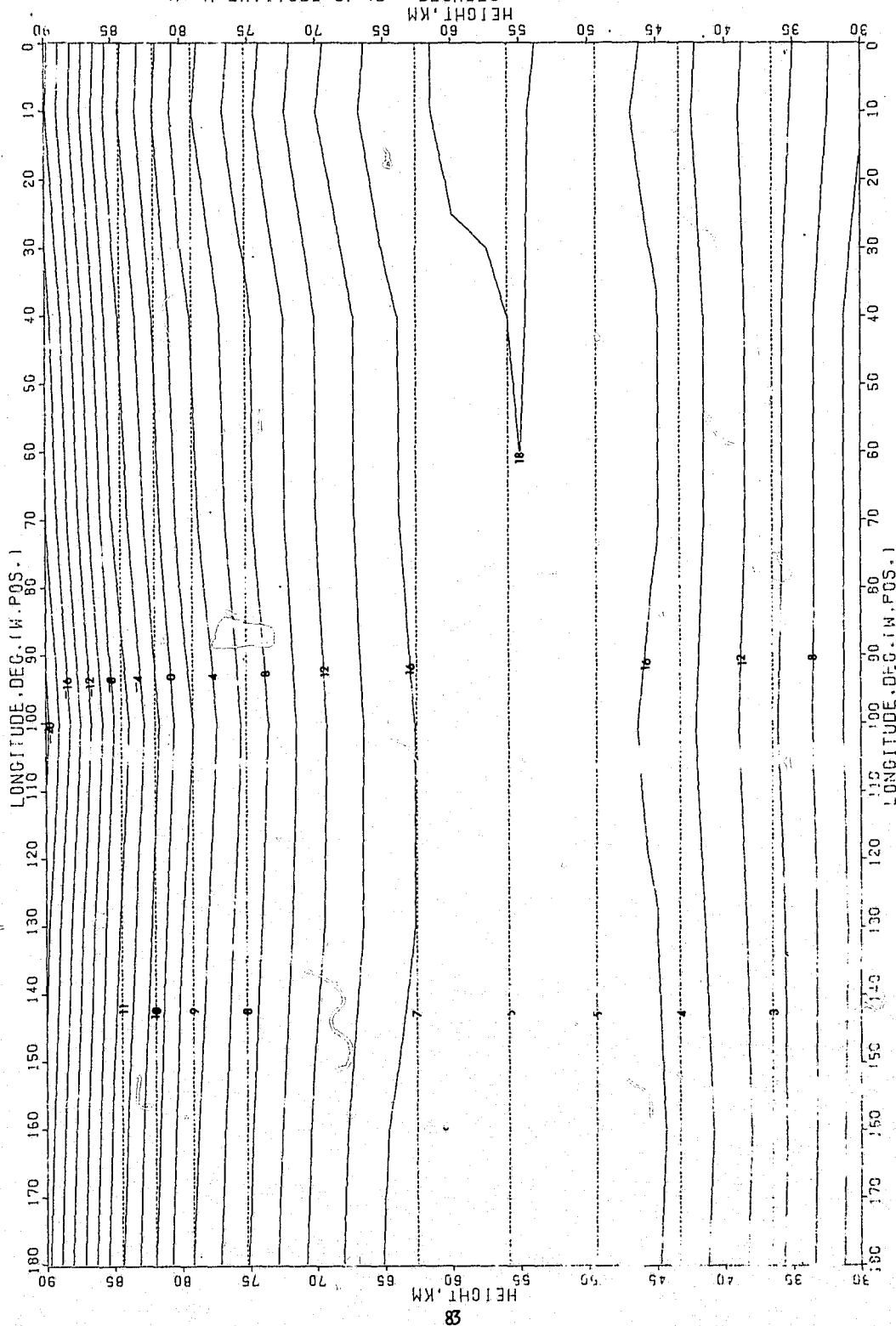


FIG 74

KEY-

—— UPPER 99TH PERCENTILE OF PRESSURE
 LOWER 99TH PERCENTILE OF PRESSURE
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

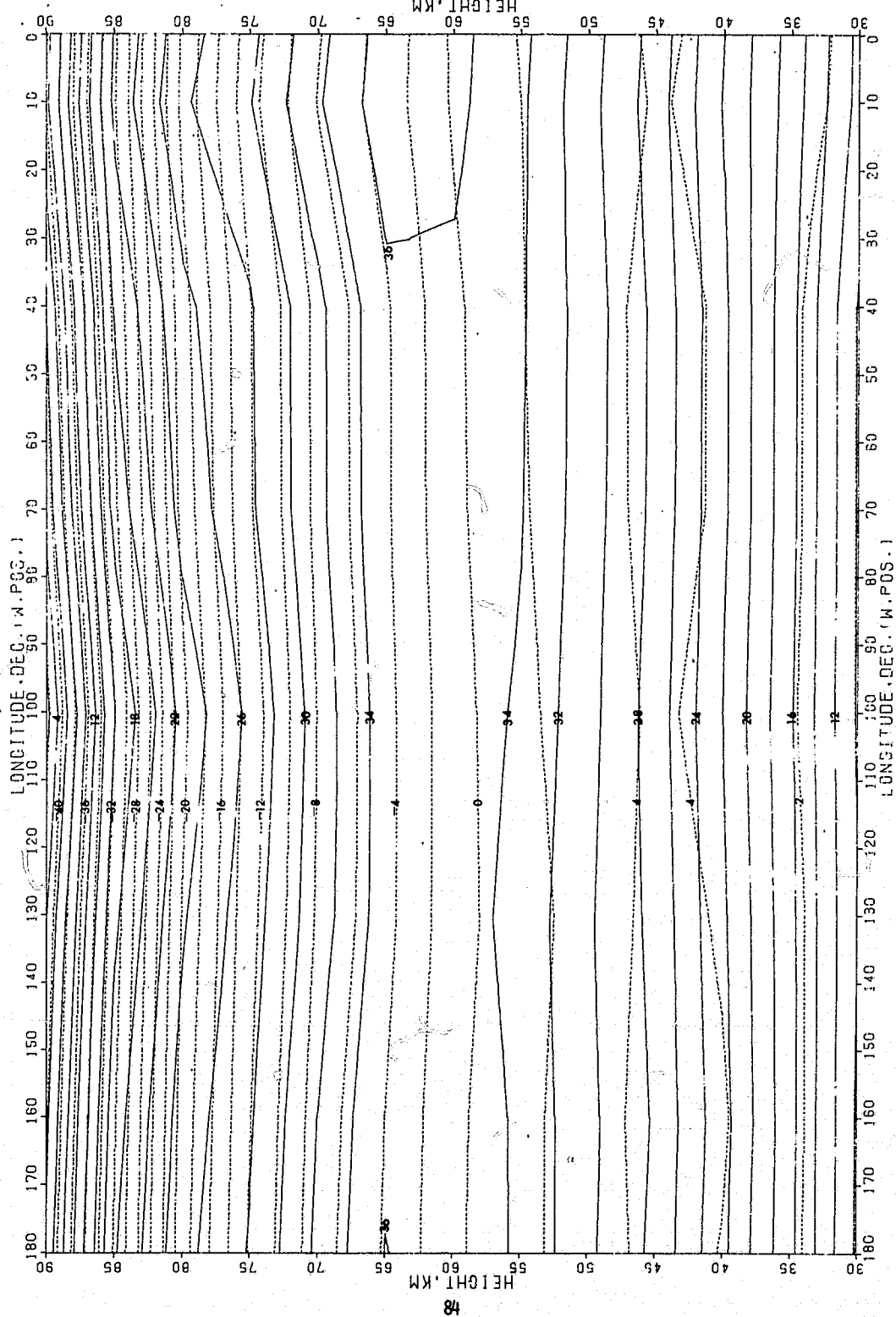


FIG 75

KEY.

—— DENSITY, PER CENT, DEV. FROM STD. ATM.

----- STD. DEV. OF DENSITY
DURING MONTH OF JULY
AT A LATITUDE OF 45 DEGREES

MM. 11013H

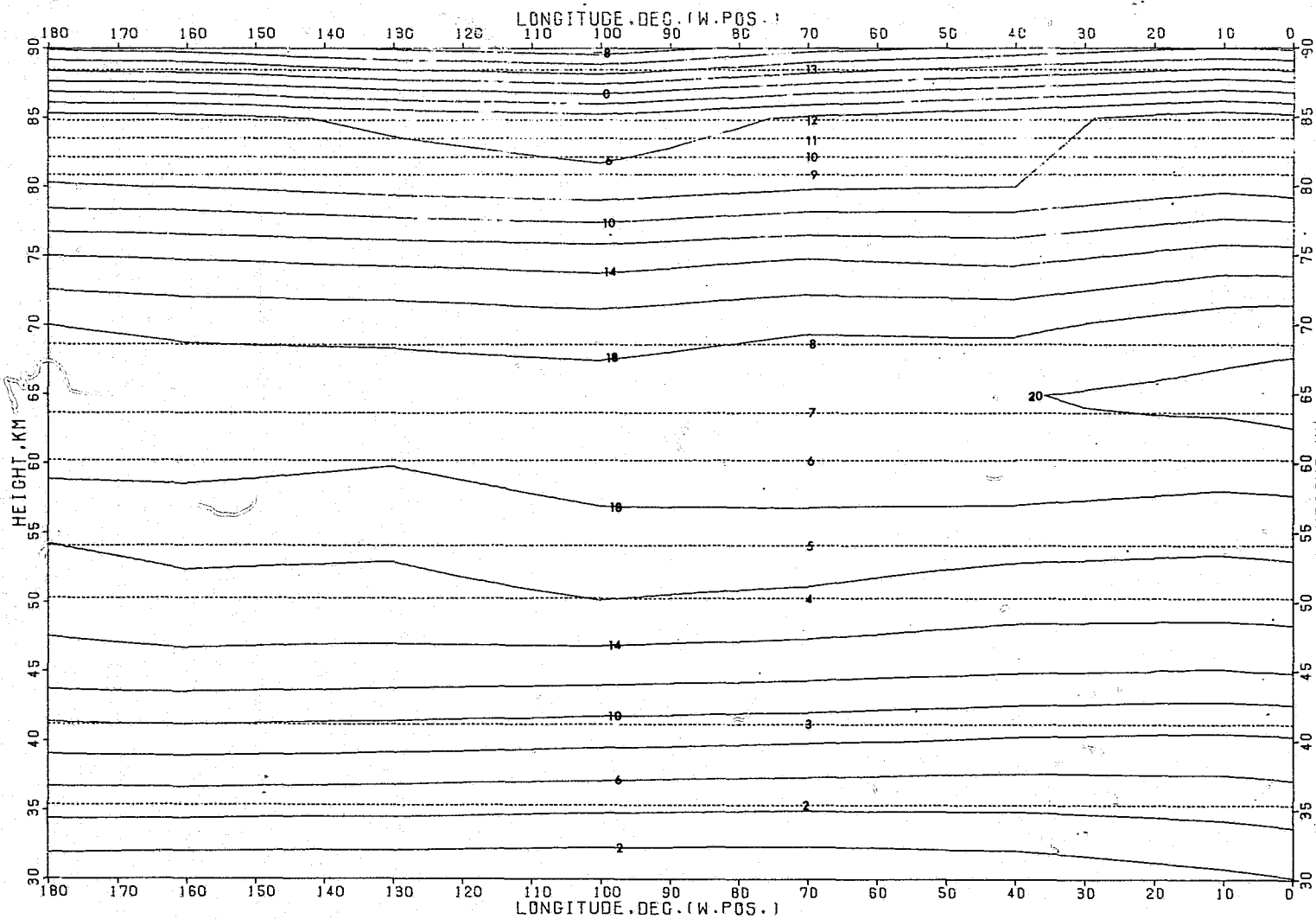
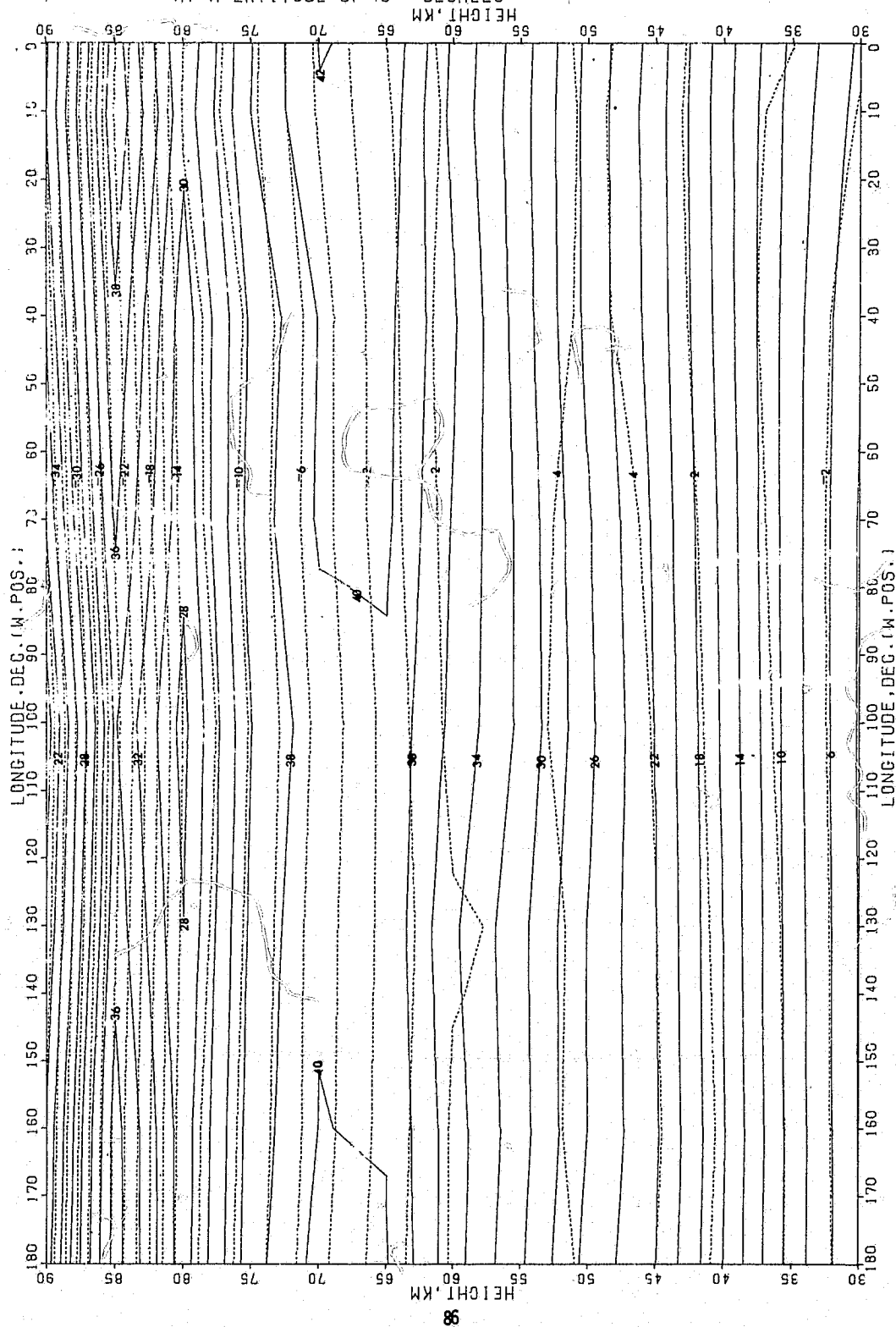


FIG 76

KEY-

—— UPPER 99TH PERCENTILE OF DENSITY
 LOWER 99TH PERCENTILE OF DENSITY
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES



KEY-

FIG 77

TEMPERATURE, DEG. K
 STD. DEV. OF TEMPERATURE
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES
 N. 11013H

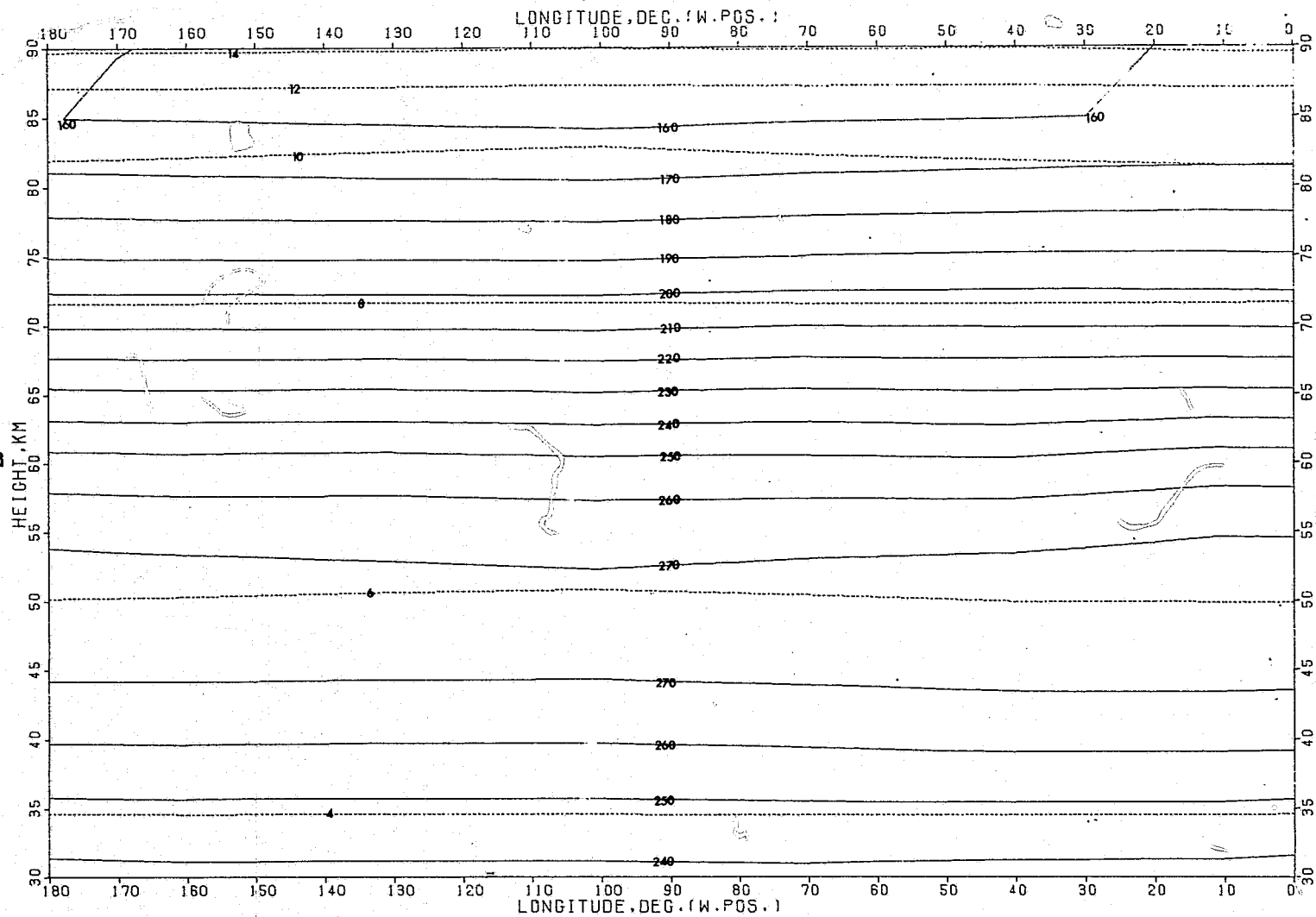


FIG 78

KEY-

----- UPPER 99TH PERCENTILE OF TEMPERATURE
 LOWER 99TH PERCENTILE OF TEMPERATURE
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

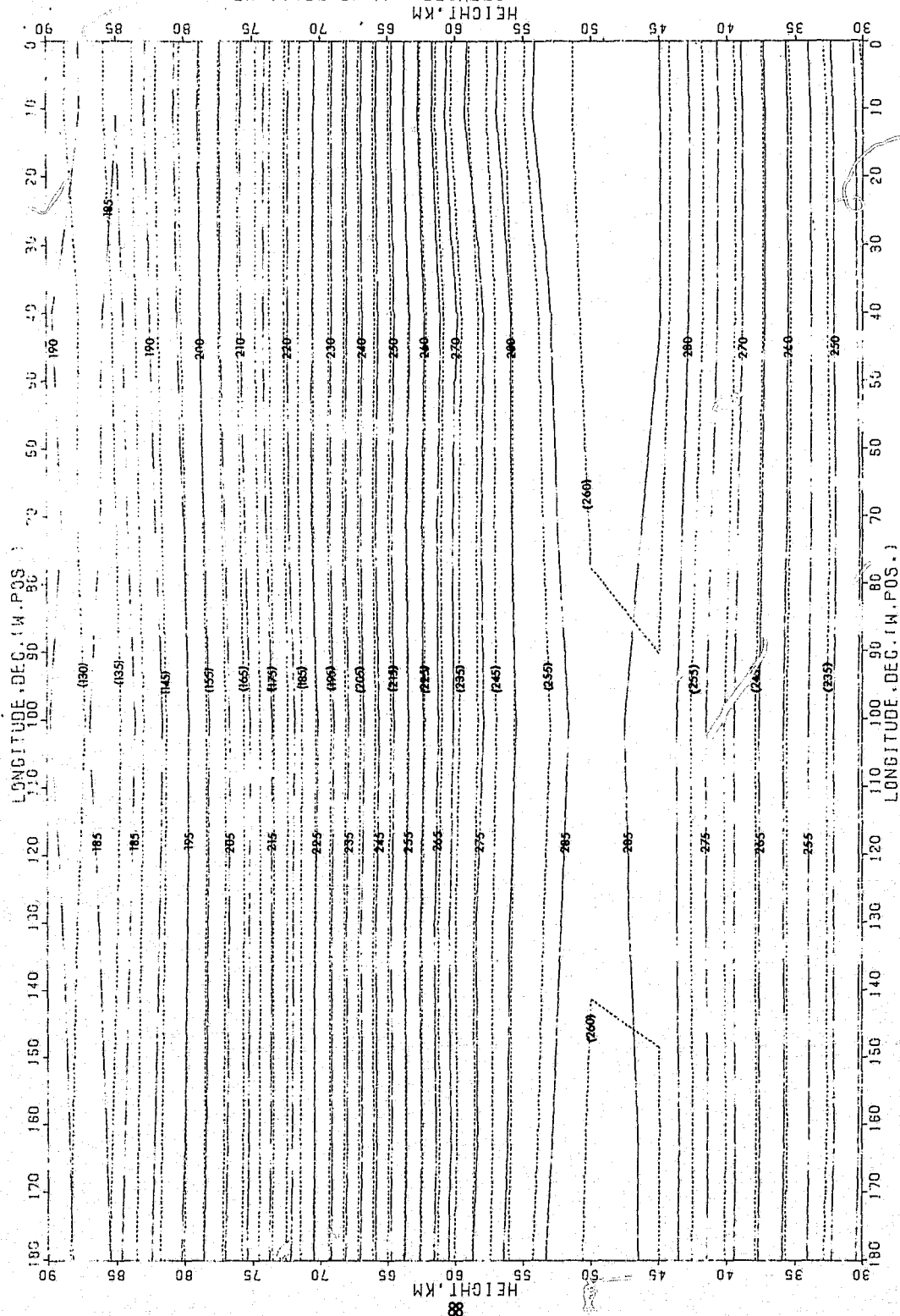


FIG 79

KEY-

— EASTWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - - - STD. DEV. OF EASTWARD WIND
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

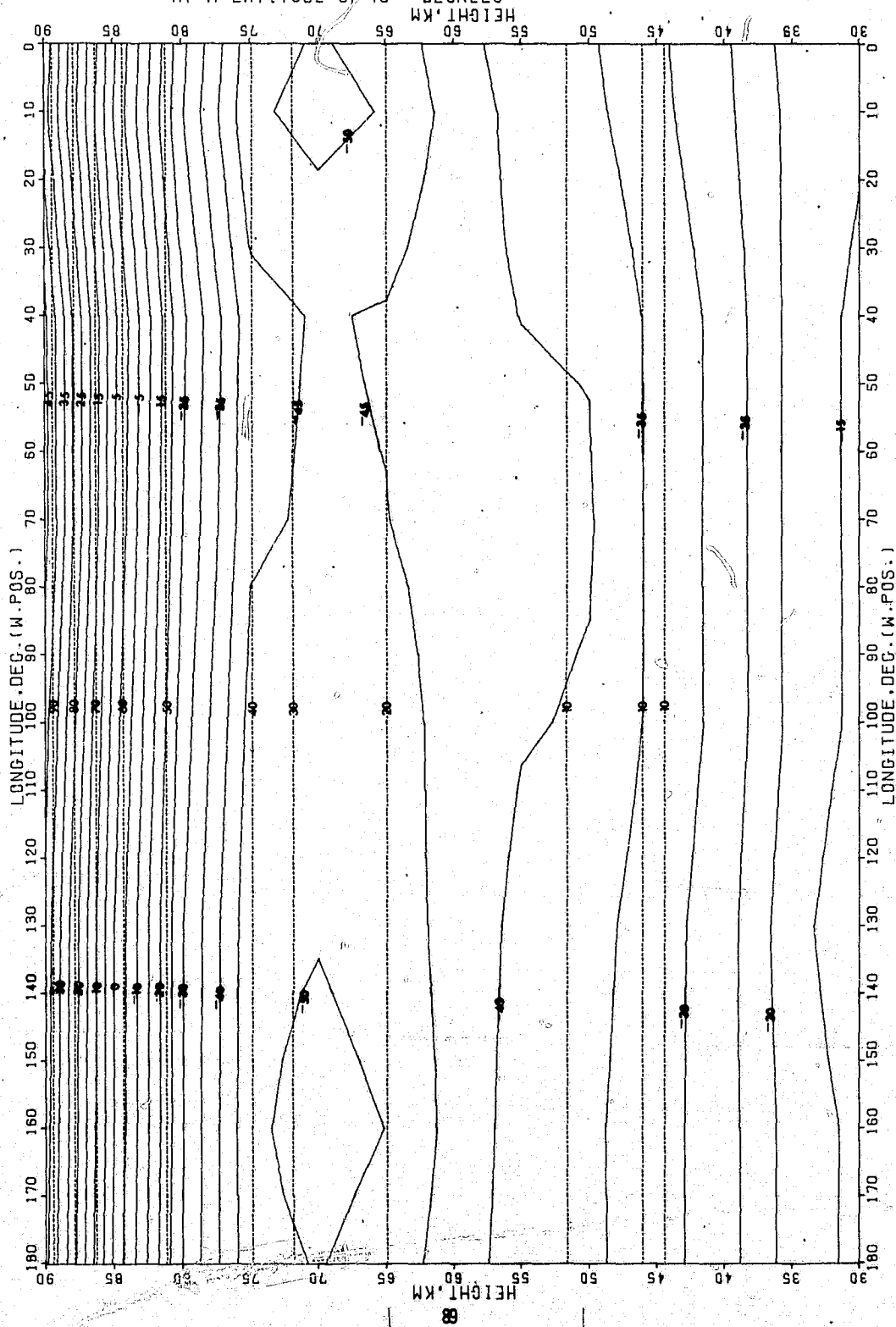


FIG 80

KEY-

- UPPER 99TH PERCENTILE OF EASTWARD WIND
 - - - - - LOWER 99TH PERCENTILE OF EASTWARD WIND
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

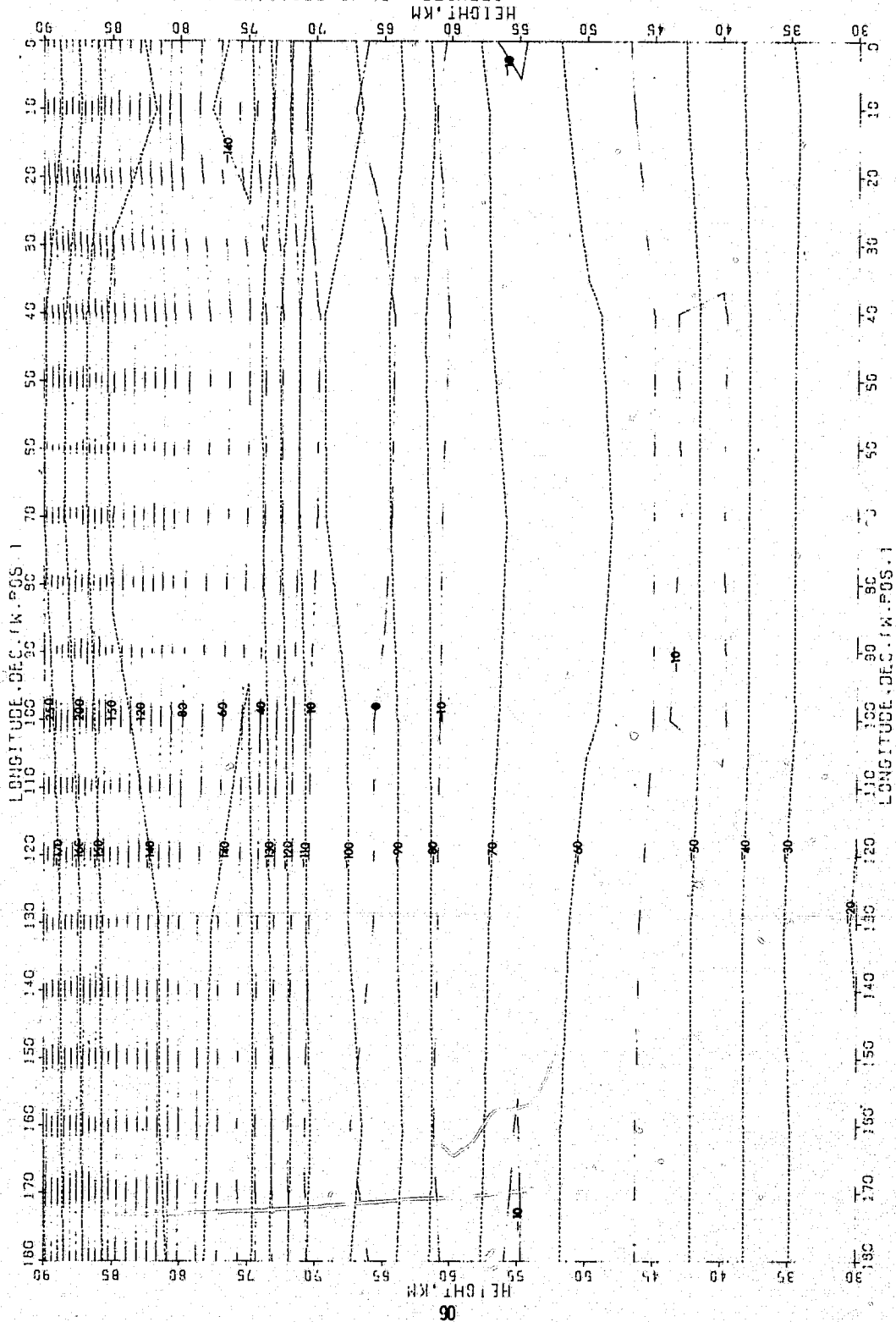


FIG 81

KEY-

— NORTHWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - - - STD. DEV. OF NORTHWARD WIND
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

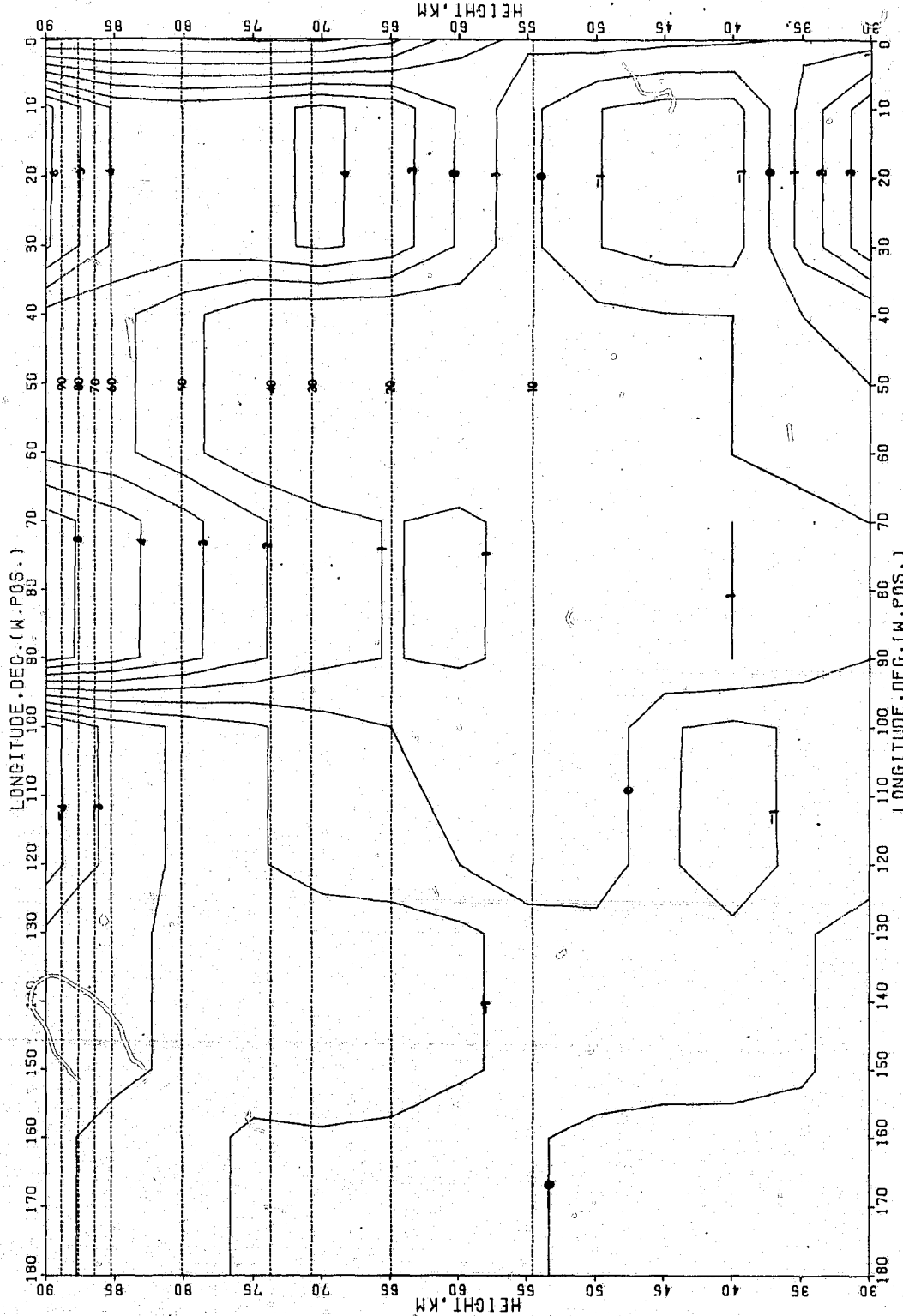
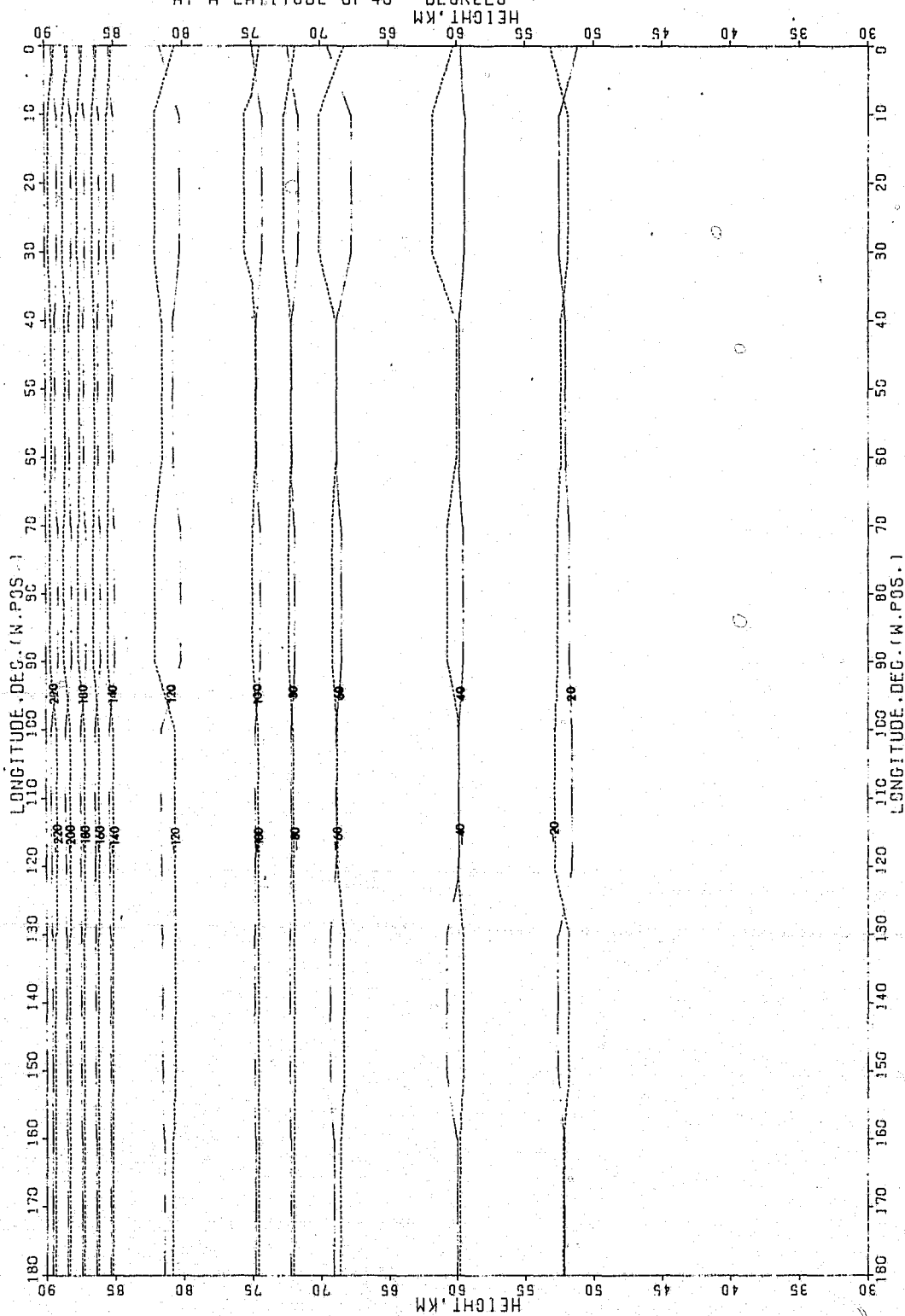


FIG 82

KEY-

----- UPPER 99TH PERCENTILE OF NORTHWARD WIND
 ----- LOWER 99TH PERCENTILE OF NORTHWARD WIND
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES



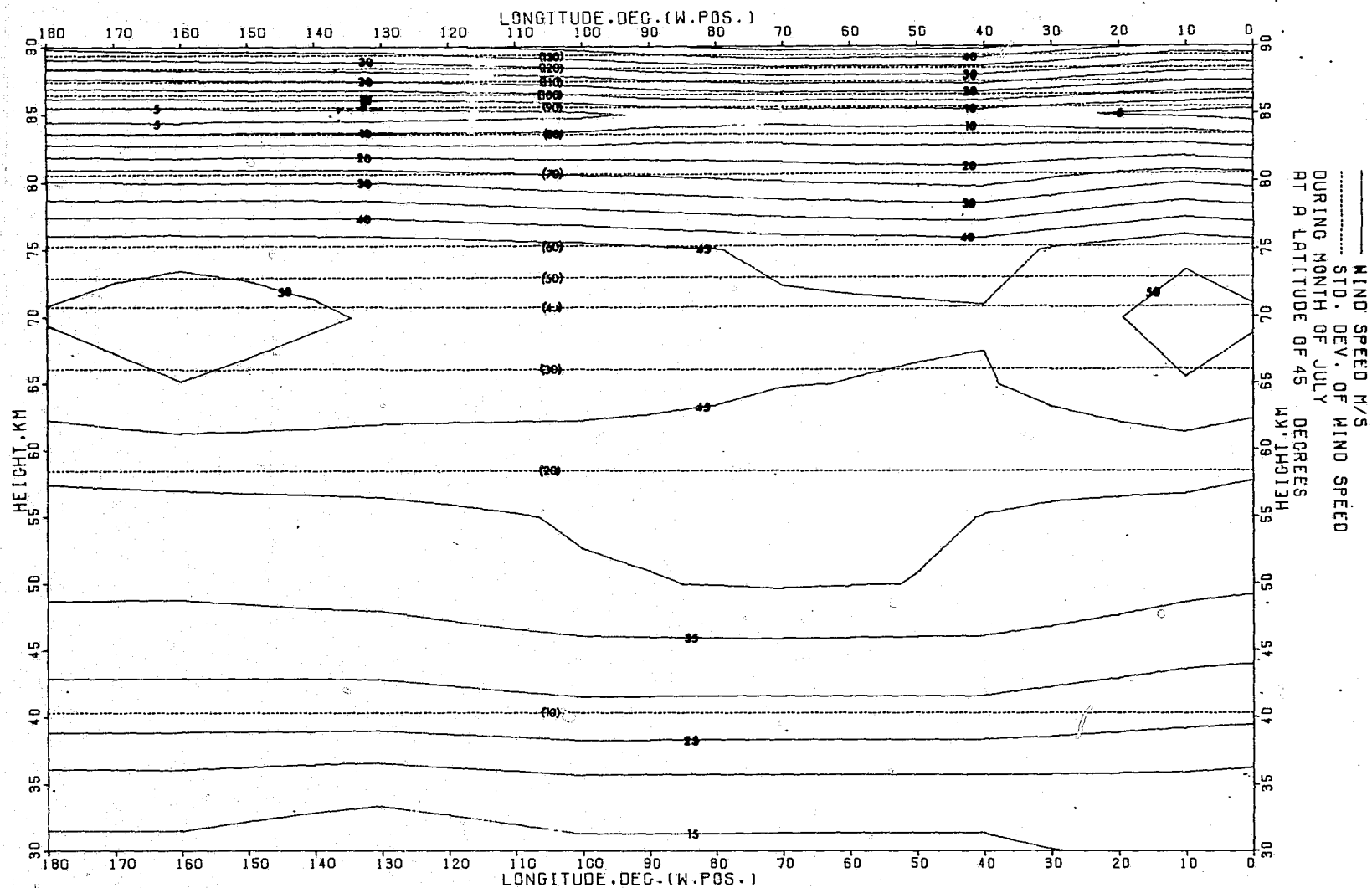


FIG 84

KEY-

—— UPPER 99TH PERCENTILE OF WIND SPEED
 - - - - - LOWER 99TH PERCENTILE OF WIND SPEED
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

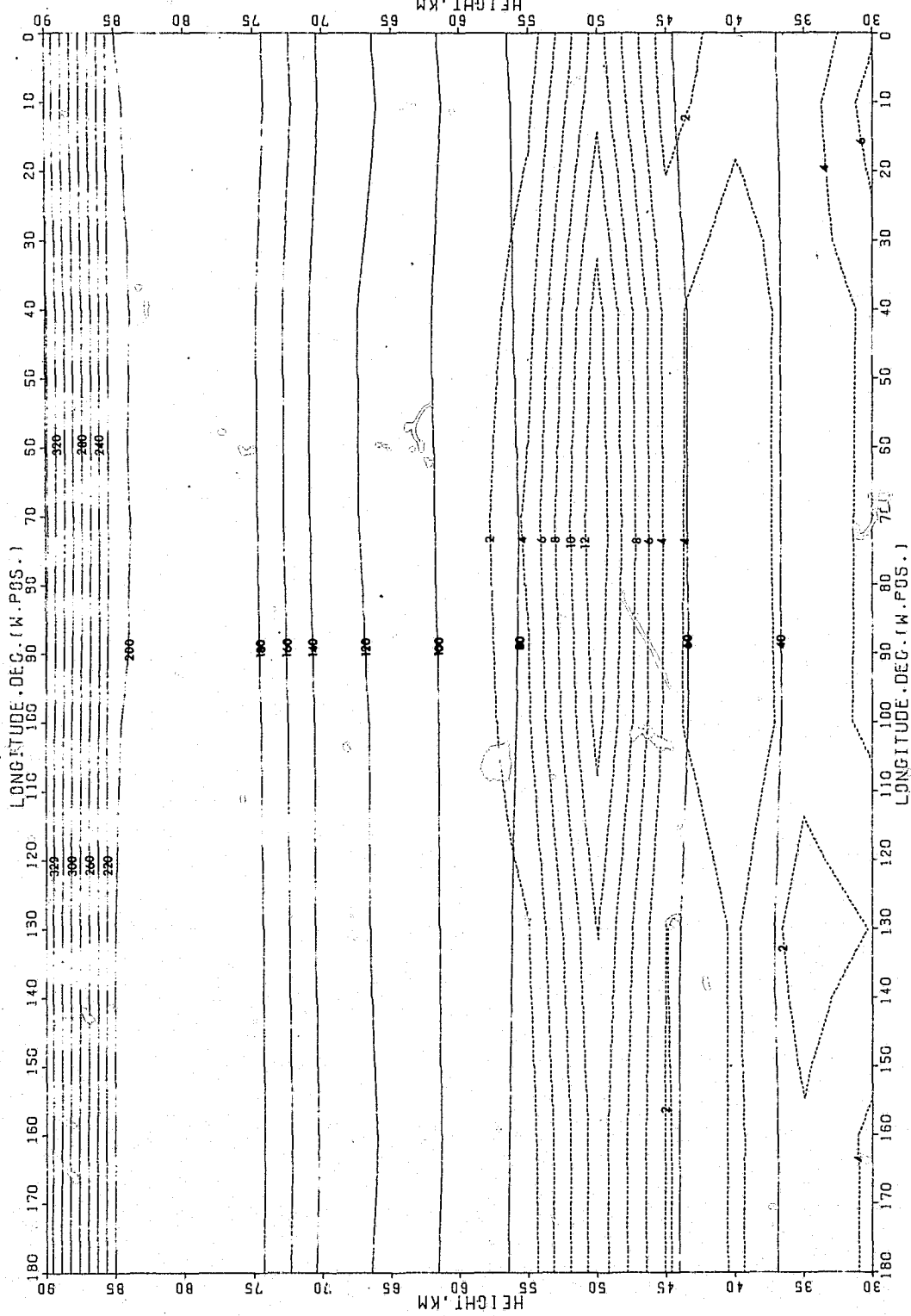


FIG 85

KEY-

——— PRESSURE, PER CENT DEV. FROM STD. ATM.
 STD. DEV. OF PRESSURE
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

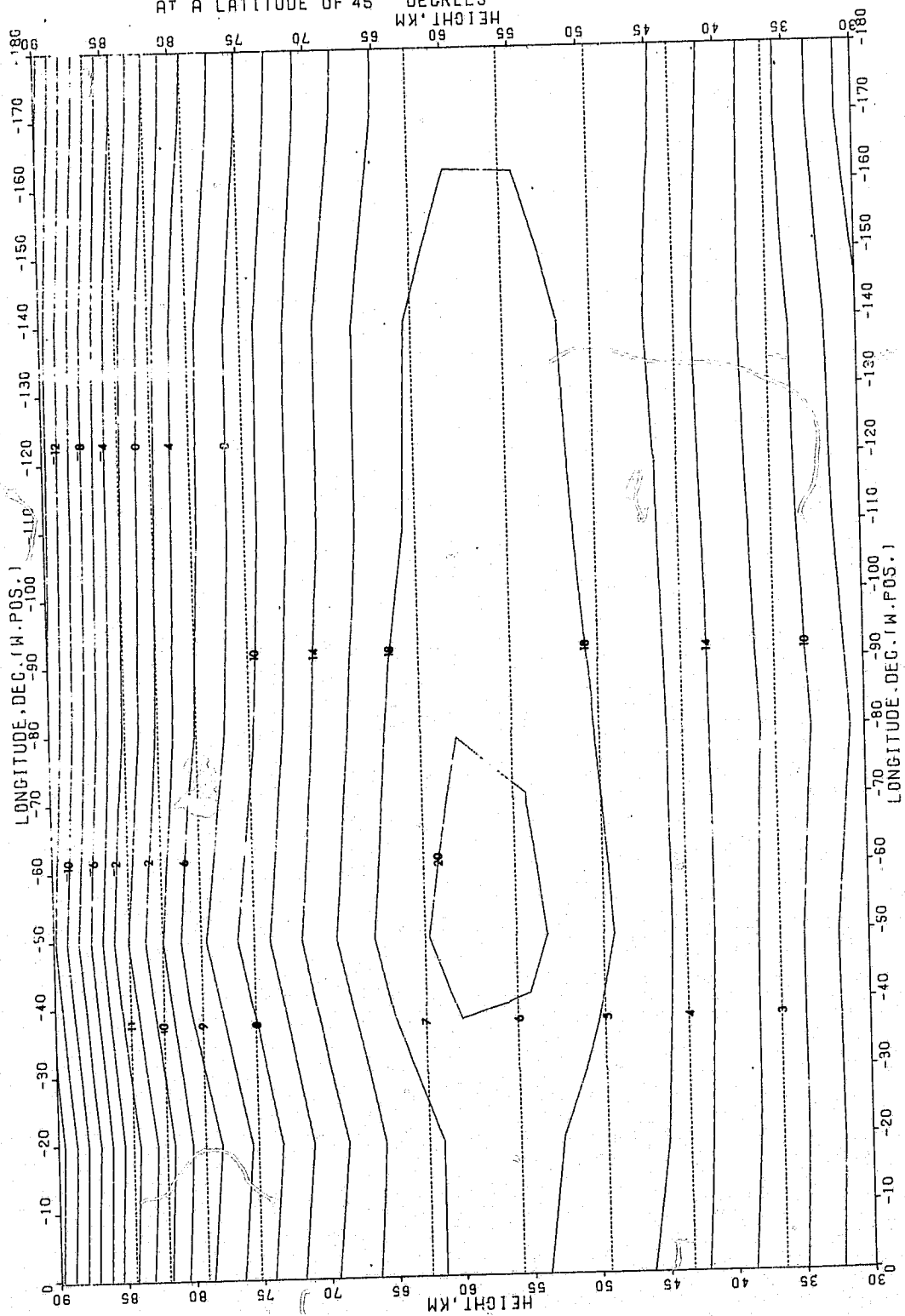
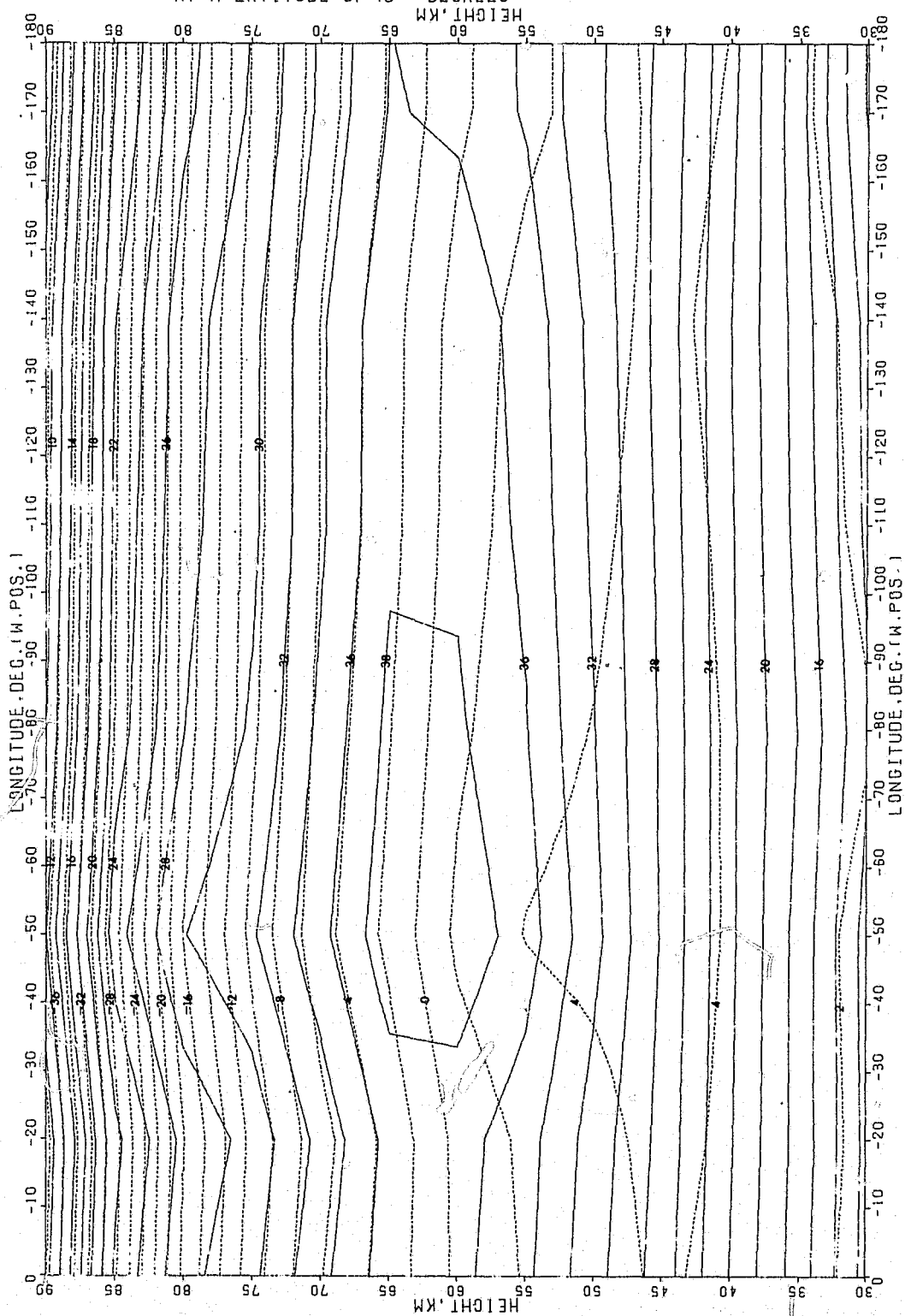


FIG 86

KEY-

— UPPER 99TH PERCENTILE OF PRESSURE
 - - - LOWER 99TH PERCENTILE OF PRESSURE
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES



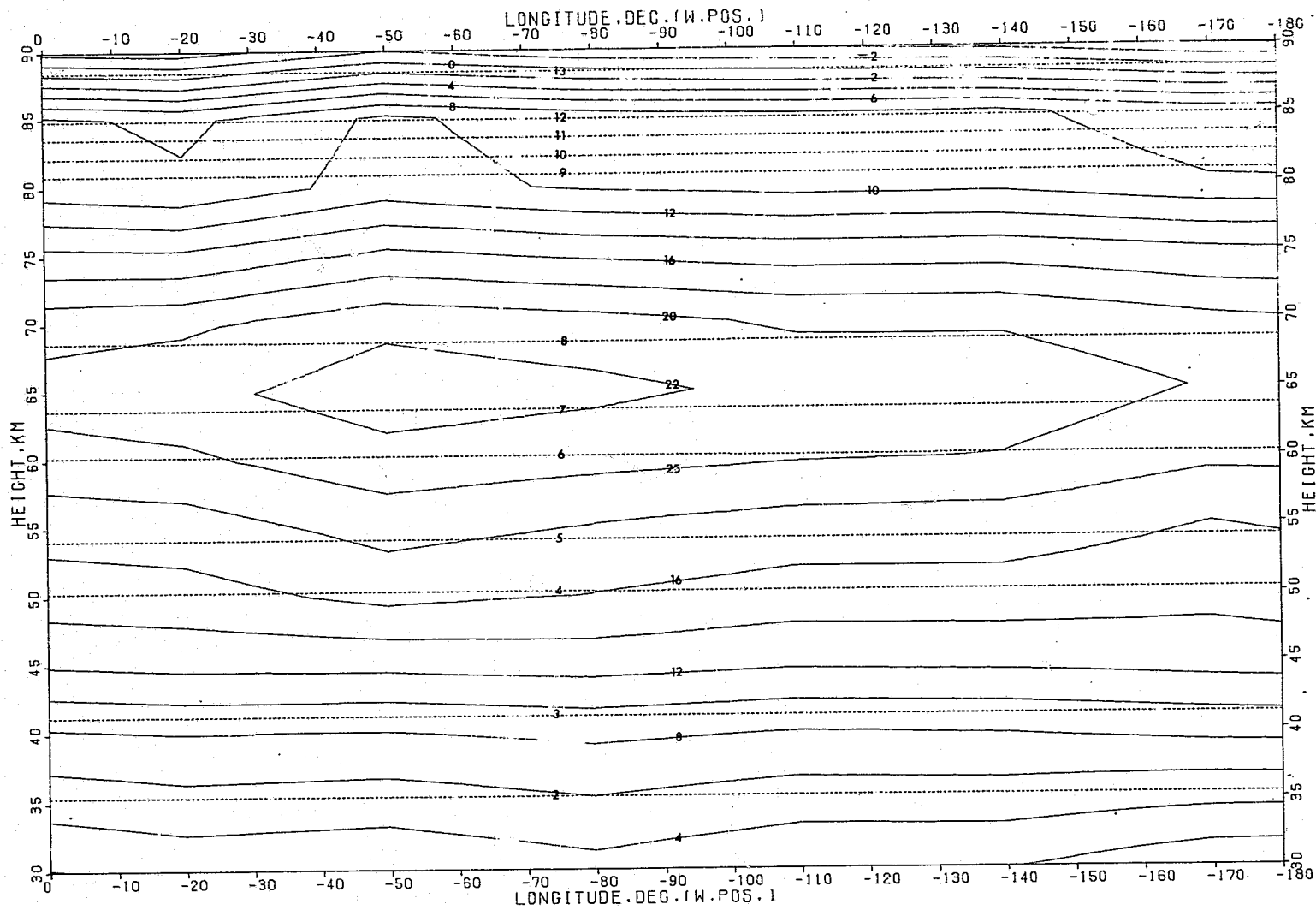


FIG 87

FIG 88

KEY-

— — — — — UPPER 99TH PERCENTILE OF DENSITY
 - - - - - LOWER 99TH PERCENTILE OF DENSITY
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

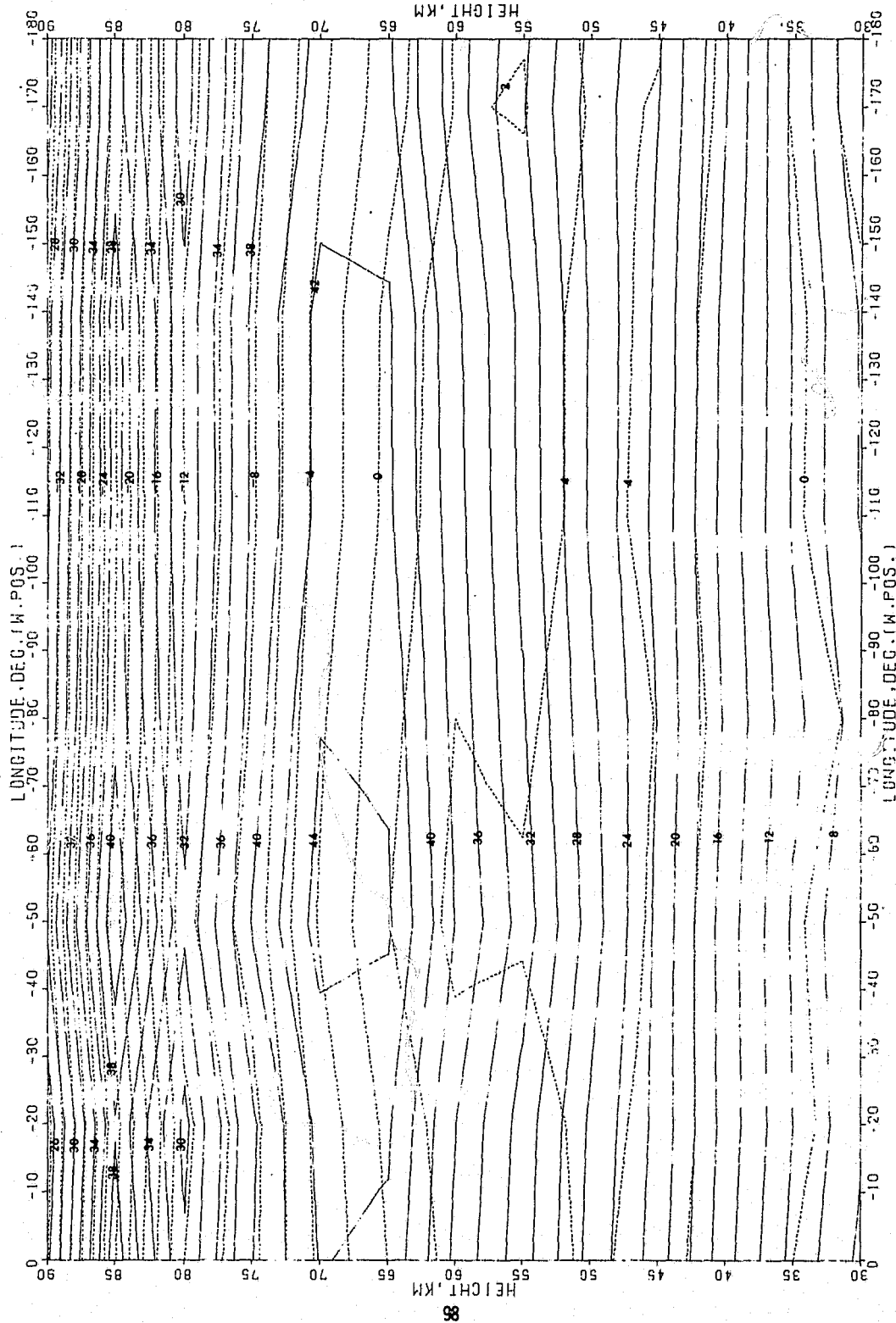


FIG 89

KEY

TEMPERATURE, DEG. K
 STD. DEV. OF TEMPERATURE
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES
 NW, 1913H

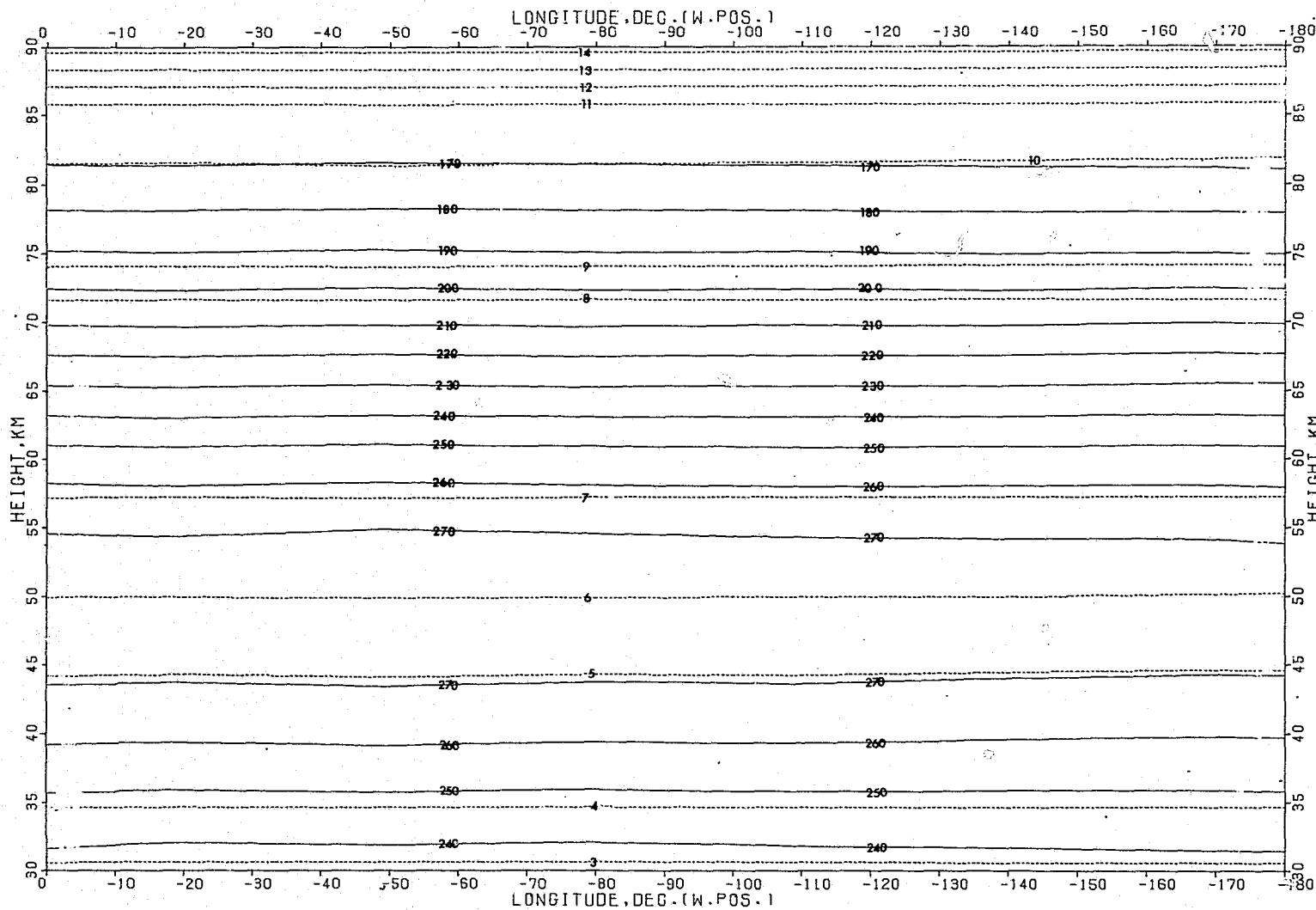


FIG 90

KEY-

----- UPPER 99TH PERCENTILE OF TEMPERATURE
 LOWER 99TH PERCENTILE OF TEMPERATURE
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

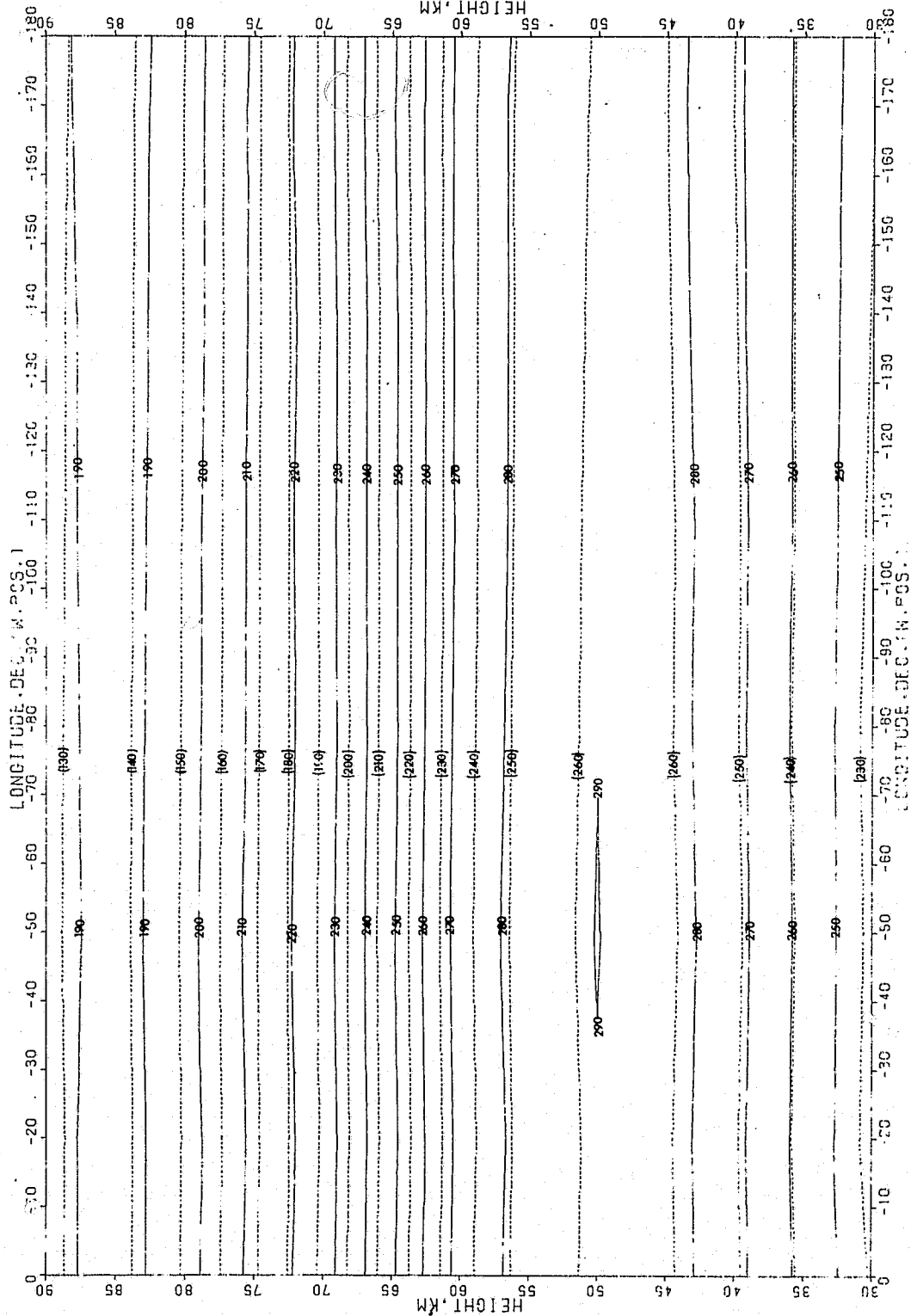
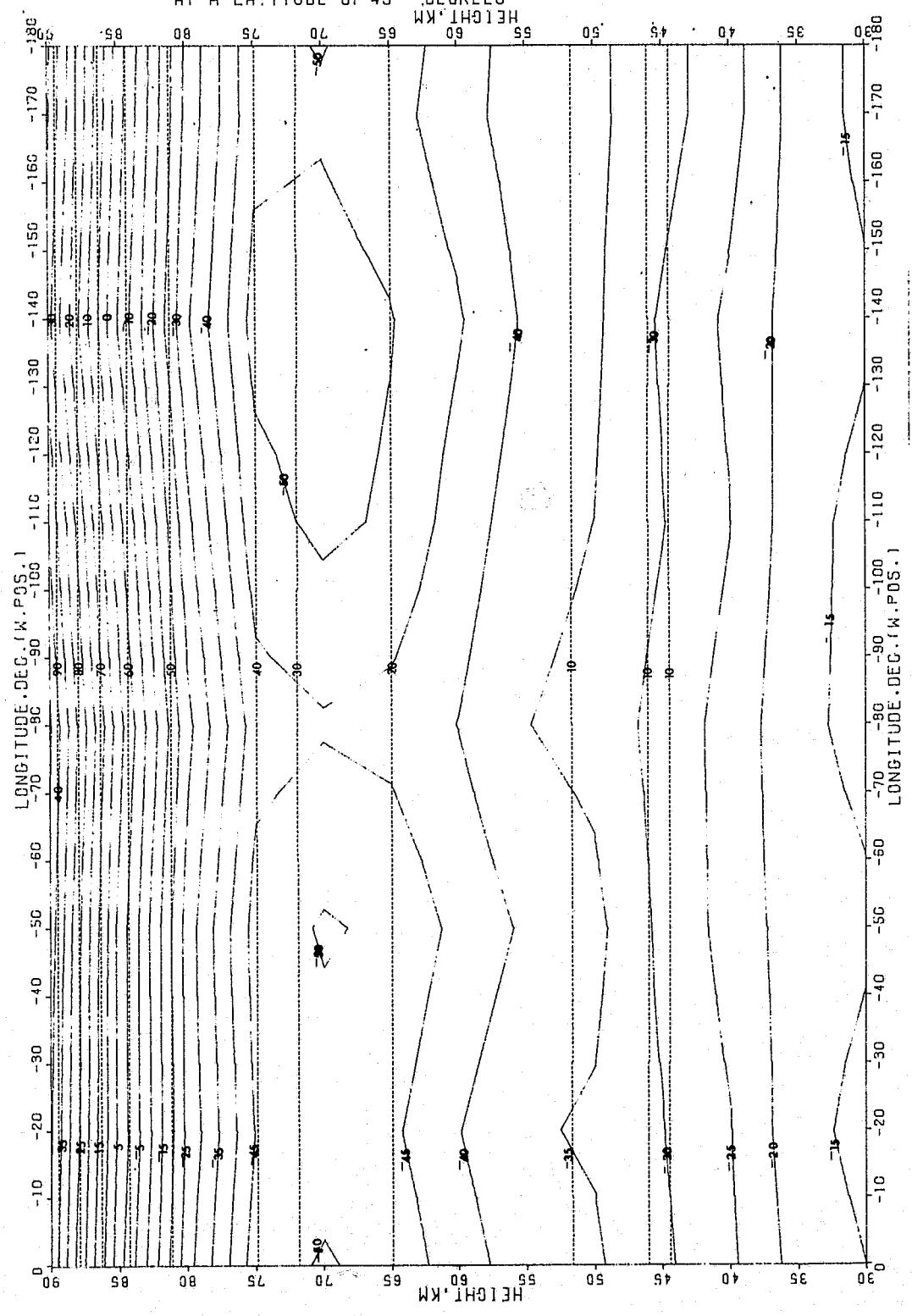


FIG 91

KEY-
—— EASTWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
- - - - - STD. DEV. OF EASTWARD WIND
DURING MONTH OF JULY
AT A LATITUDE OF 45 DEGREES



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FIG 92

KEY-

—— UPPER 99TH PERCENTILE OF EASTWARD WIND
 - - - - - LOWER 99TH PERCENTILE OF EASTWARD WIND
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

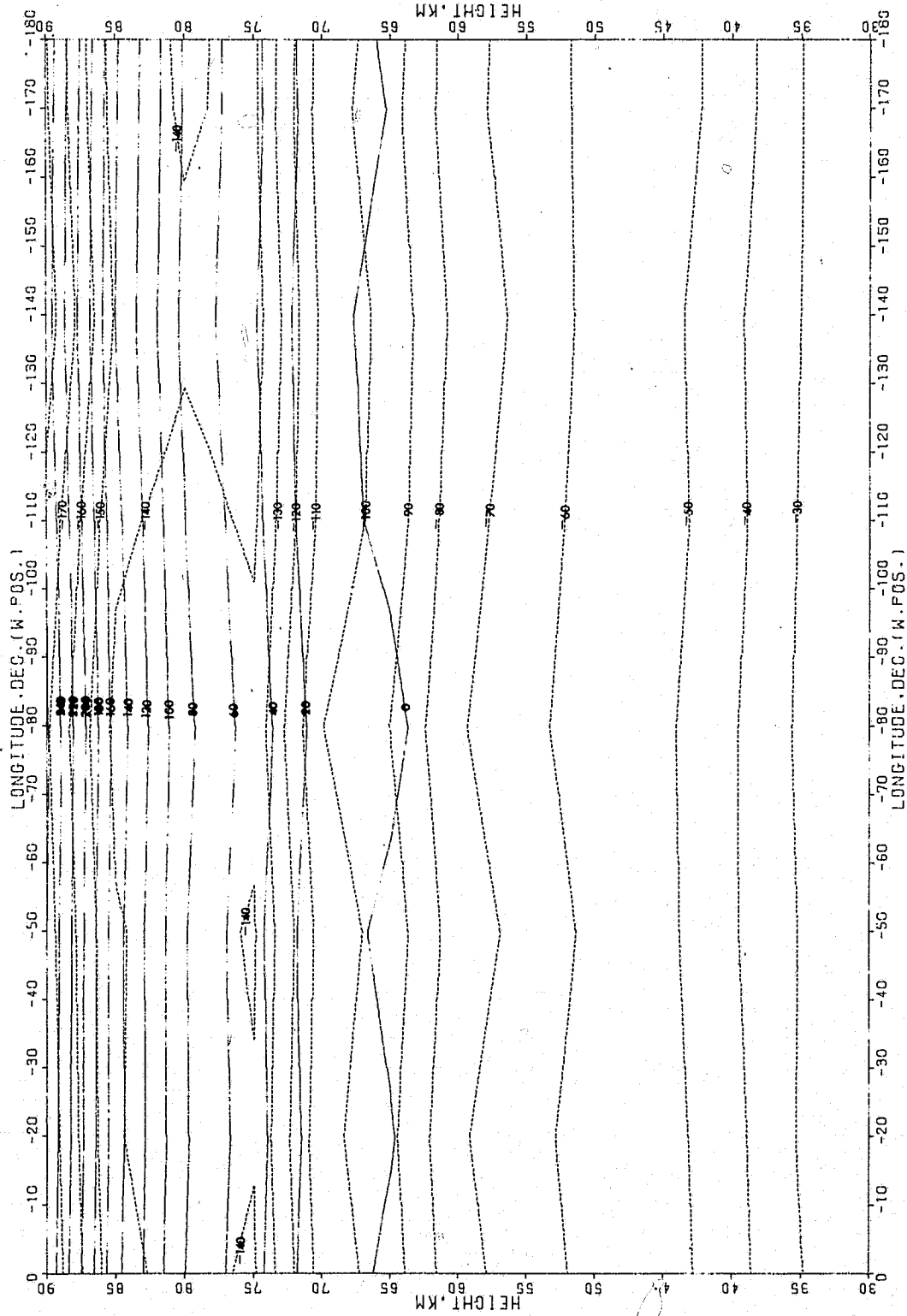


FIG 93

KEY-

—— NORTHWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - - - STD. DEV. OF NORTHWARD WIND
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

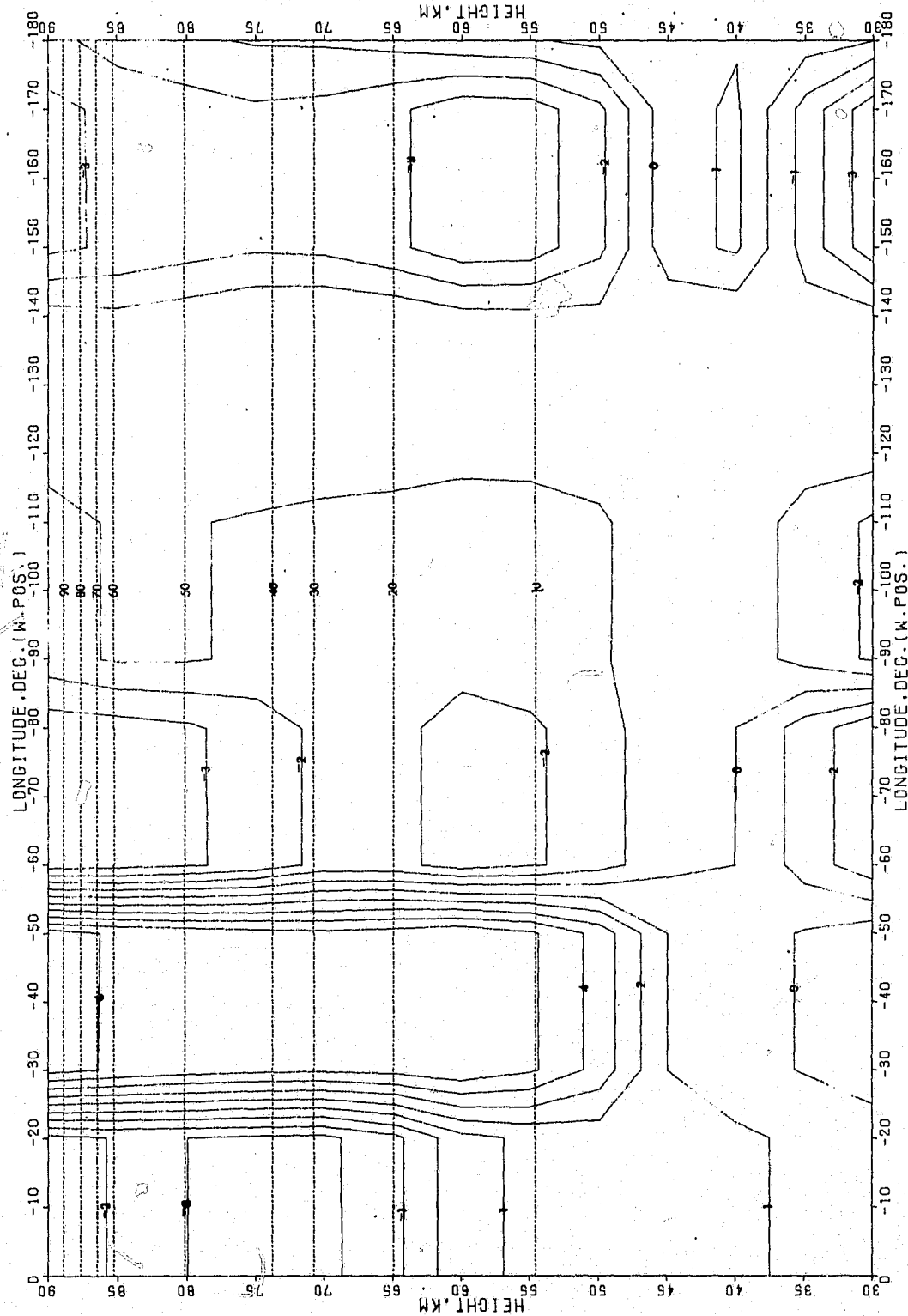
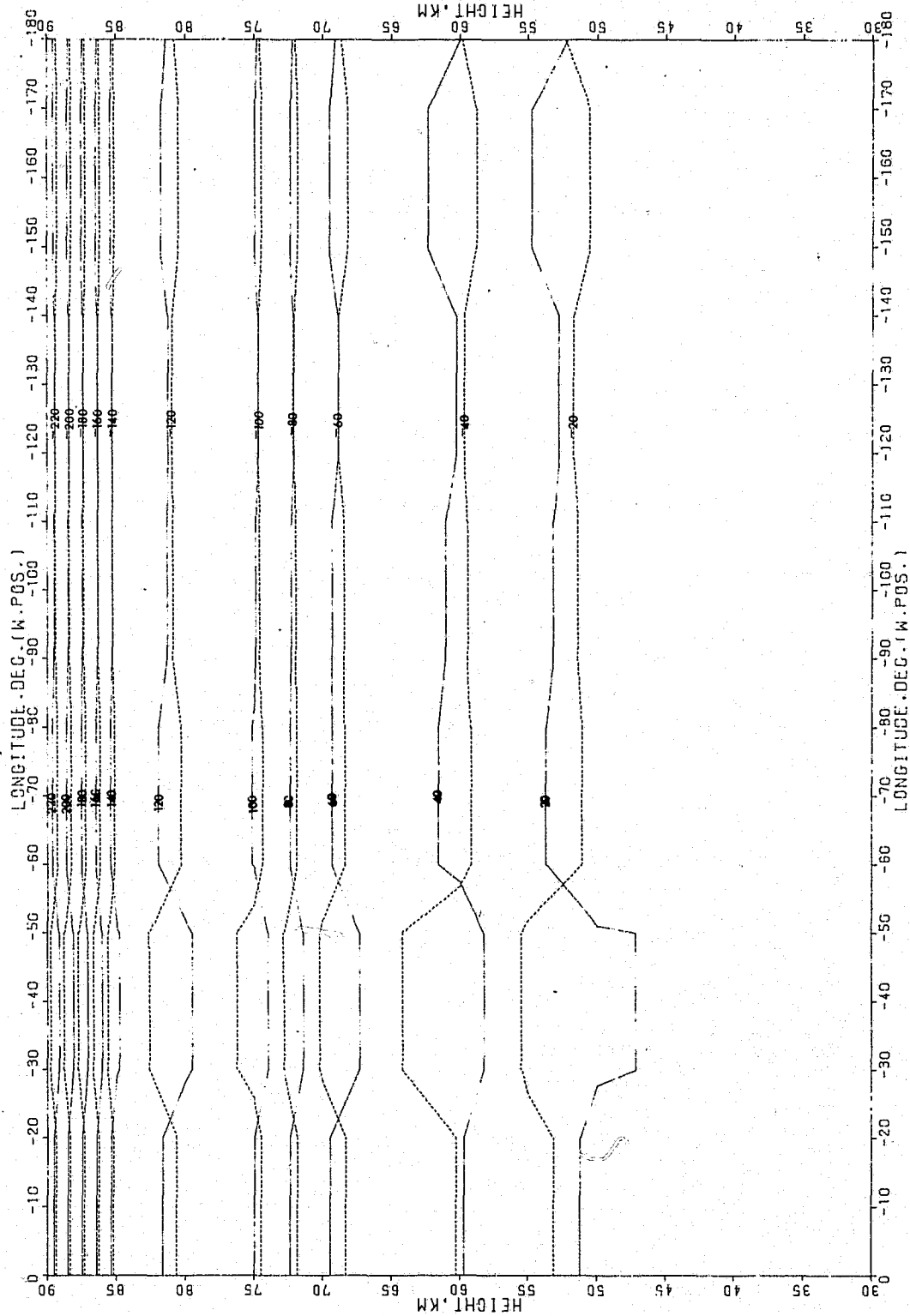


FIG 94

KEY-

—— UPPER 99TH PERCENTILE OF NORTHWARD WIND
 LOWER 99TH PERCENTILE OF NORTHWARD WIND
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES



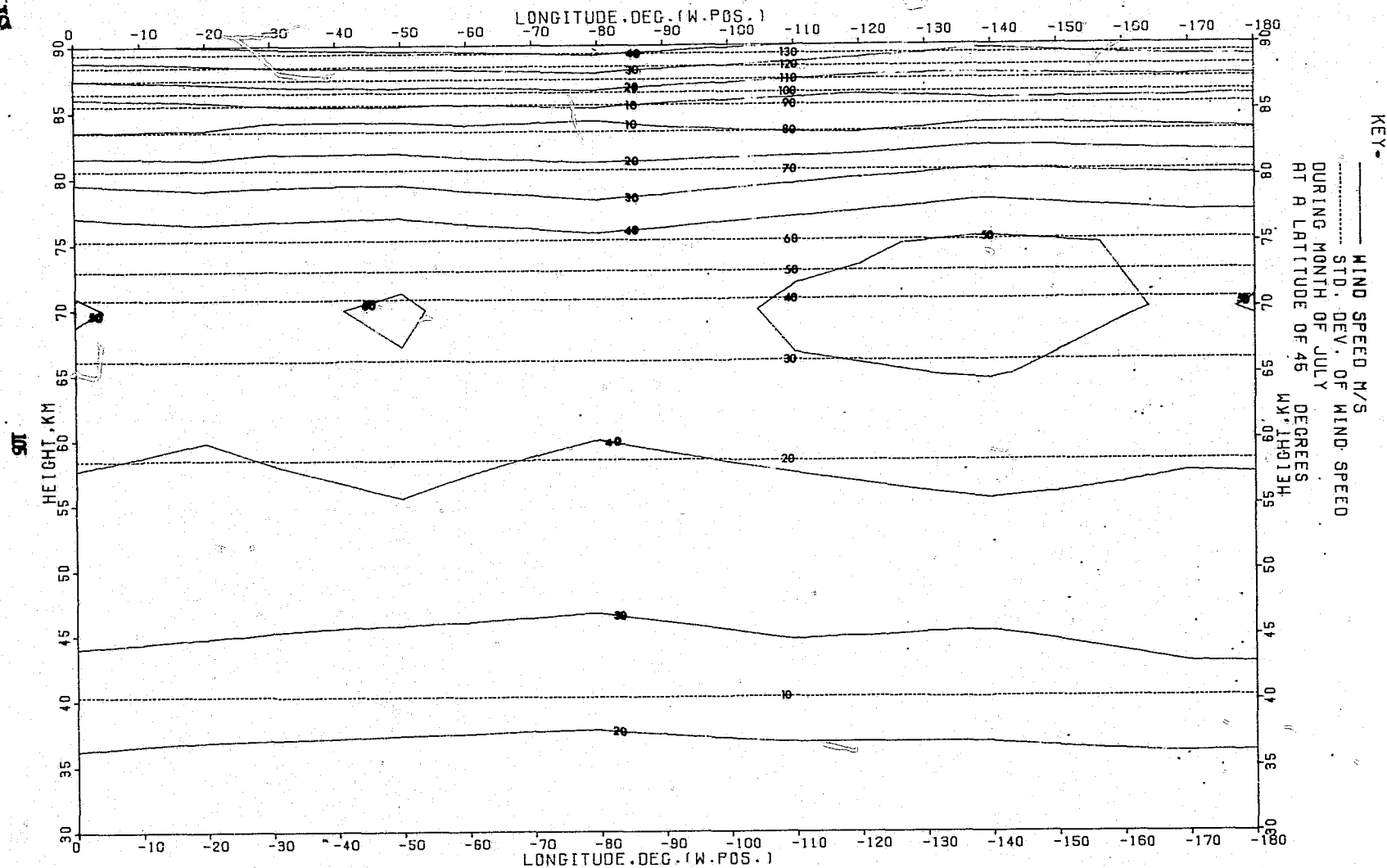


FIG 96

KEY-

—— UPPER 99TH PERCENTILE OF WIND SPEED
 - - - - LOWER 99TH PERCENTILE OF WIND SPEED
 DURING MONTH OF JULY
 AT A LATITUDE OF 45 DEGREES

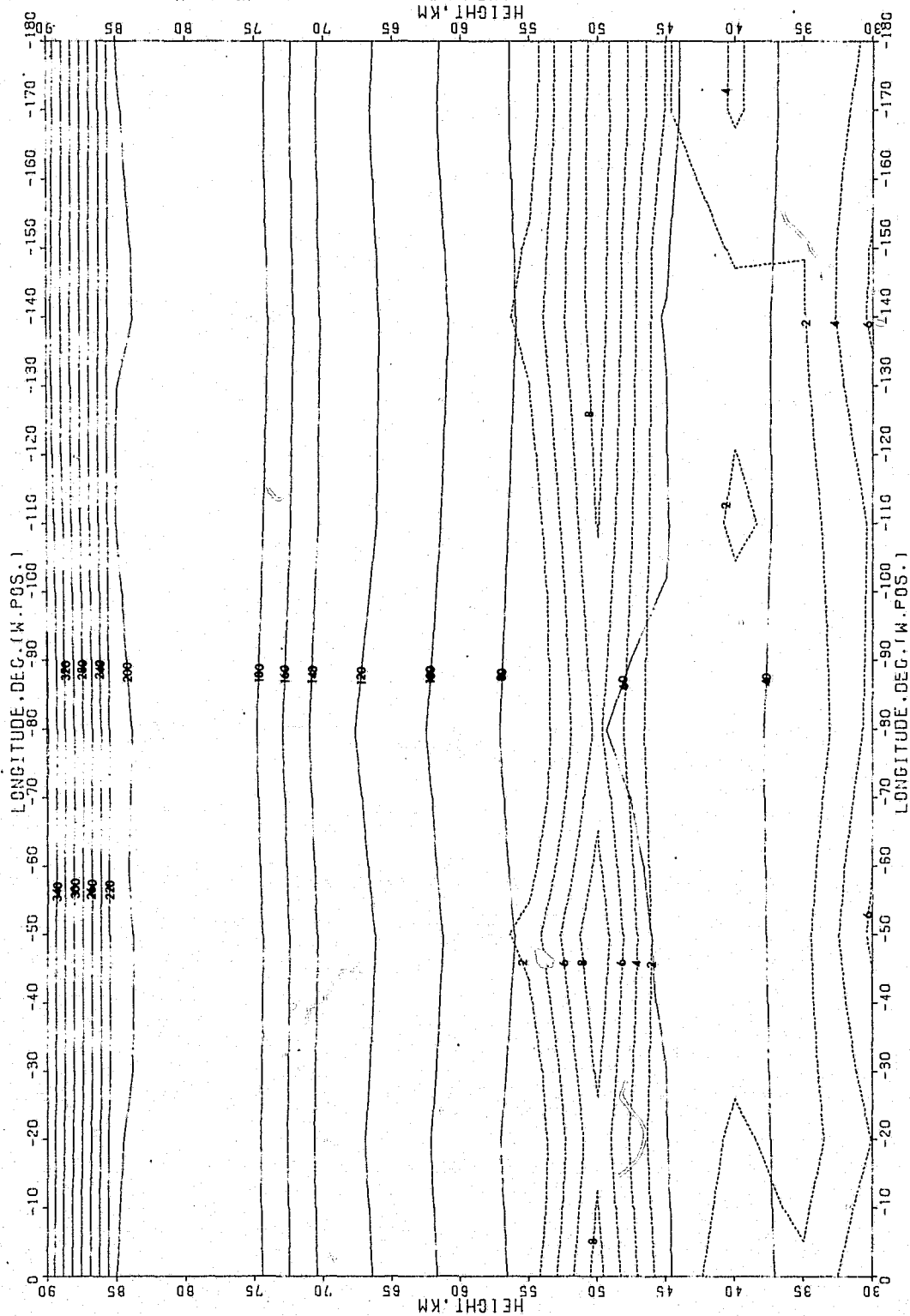


FIG 97

KEY

—— PRESSURE, PER CENT DEV. FROM STD. ATM.
 STD. DEV. OF PRESSURE
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES
 44° 14' 13" N

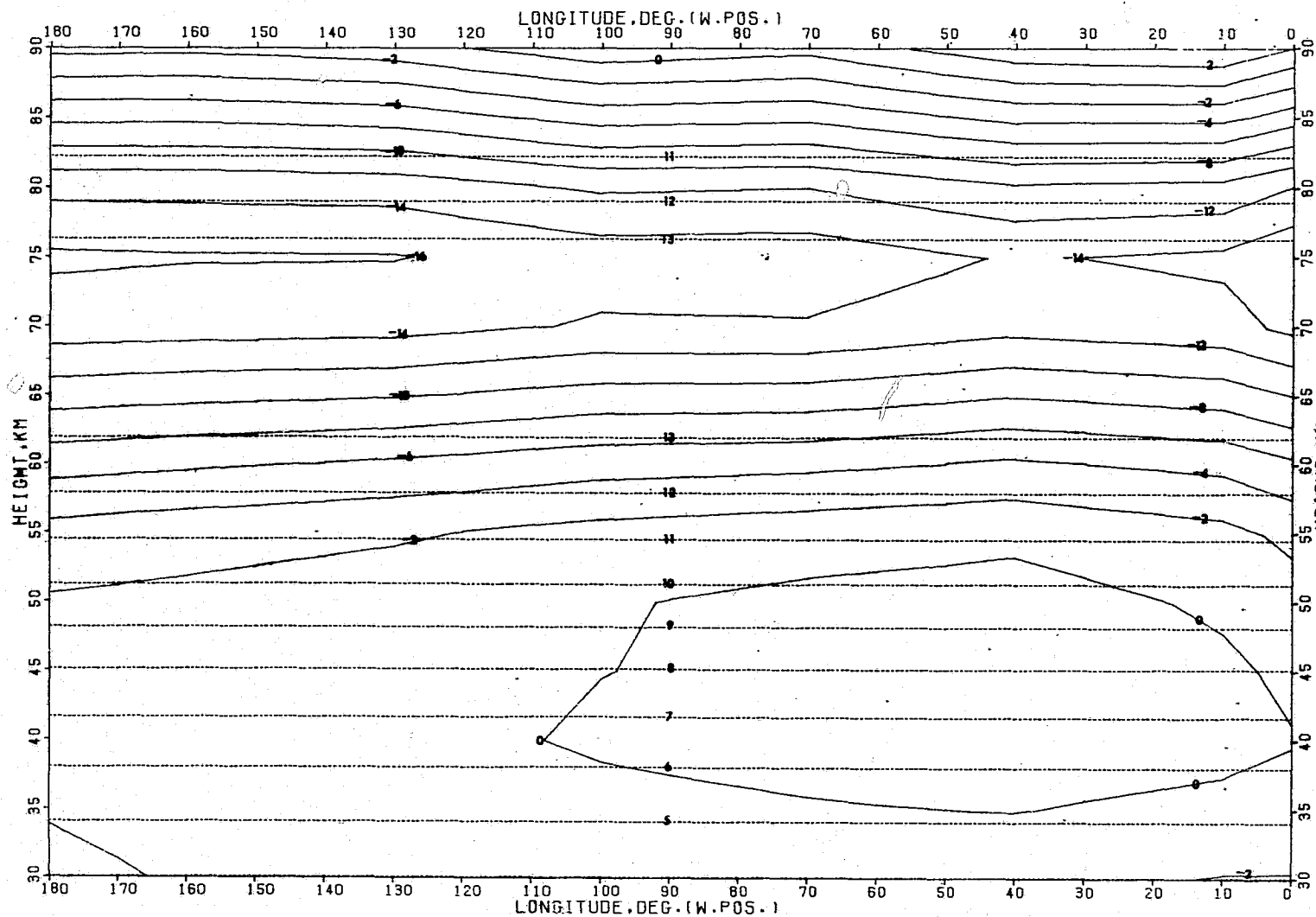


FIG 98

KEY-

— UPPER 99TH PERCENTILE OF PRESSURE
 - - - - - LOWER 99TH PERCENTILE OF PRESSURE
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

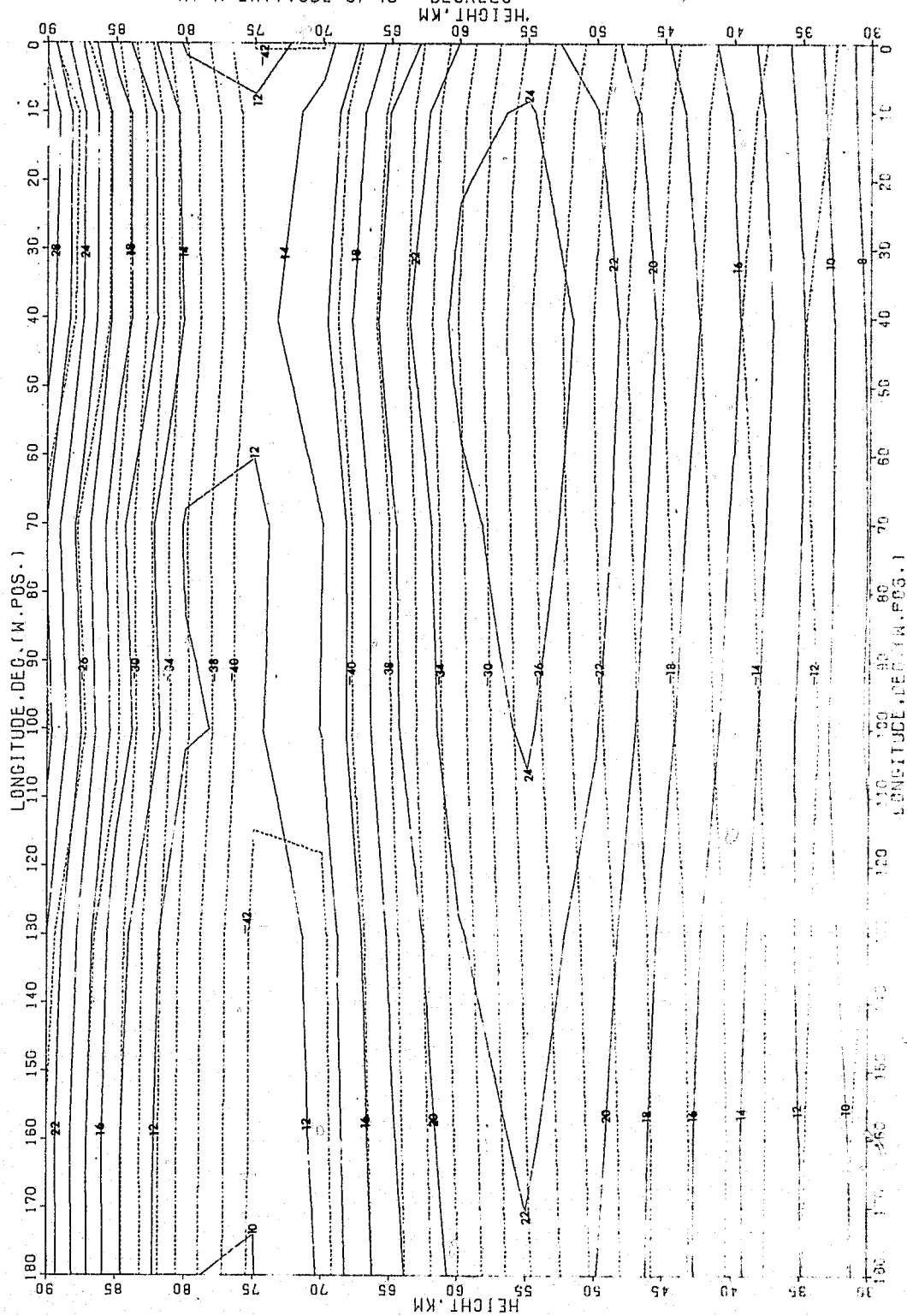


FIG 99

KEY-

— DENSITY, PER CENT DEV. FROM STD. ATM.
 STD. DEV. OF DENSITY
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

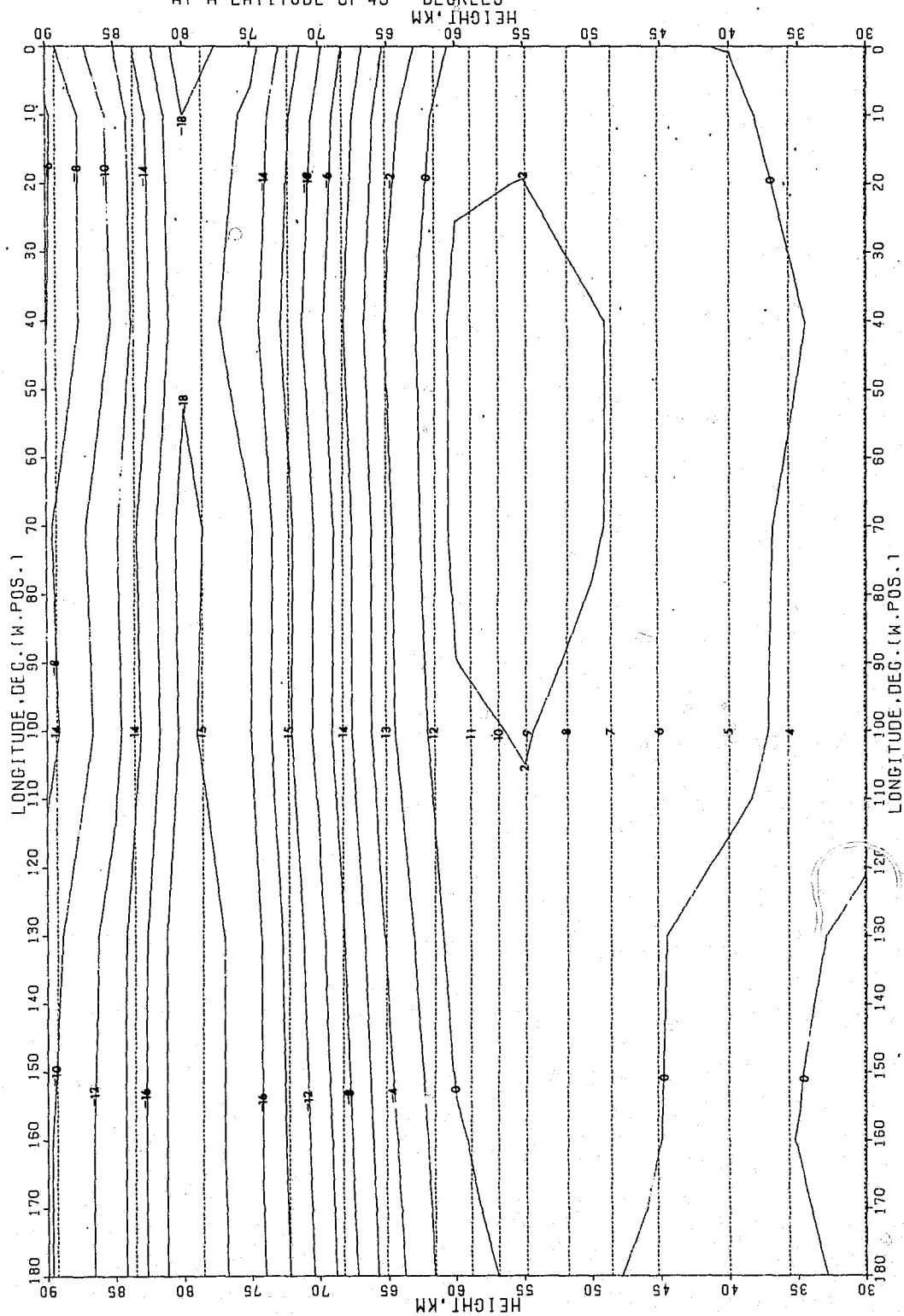


FIG 100

KEY-

----- UPPER 99TH PERCENTILE OF DENSITY
 LOWER 99TH PERCENTILE OF DENSITY
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

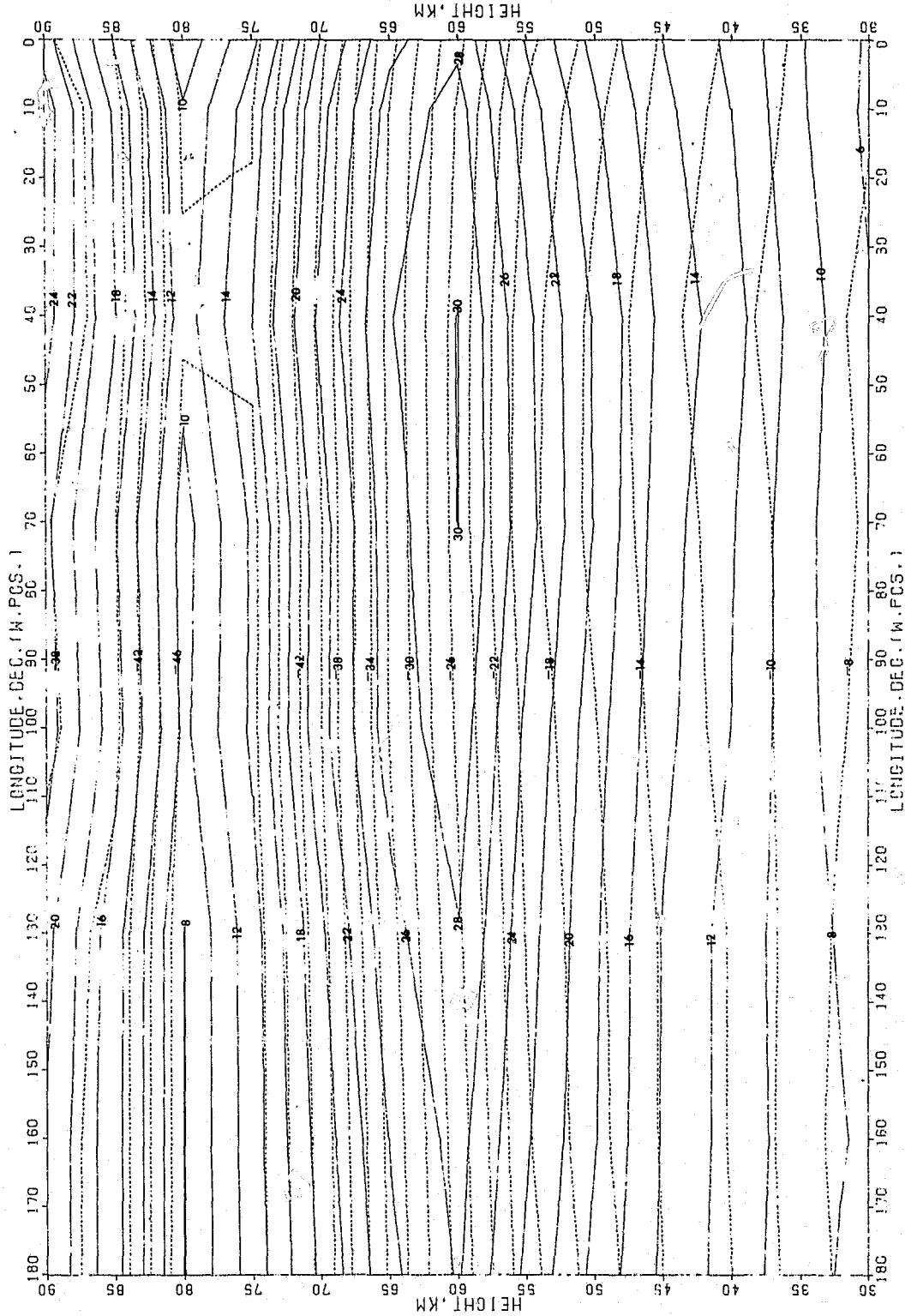


FIG 101

KEY

— TEMPERATURE, DEG. K
 STD. DEV. OF TEMPERATURE
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES
 WK. 14013H

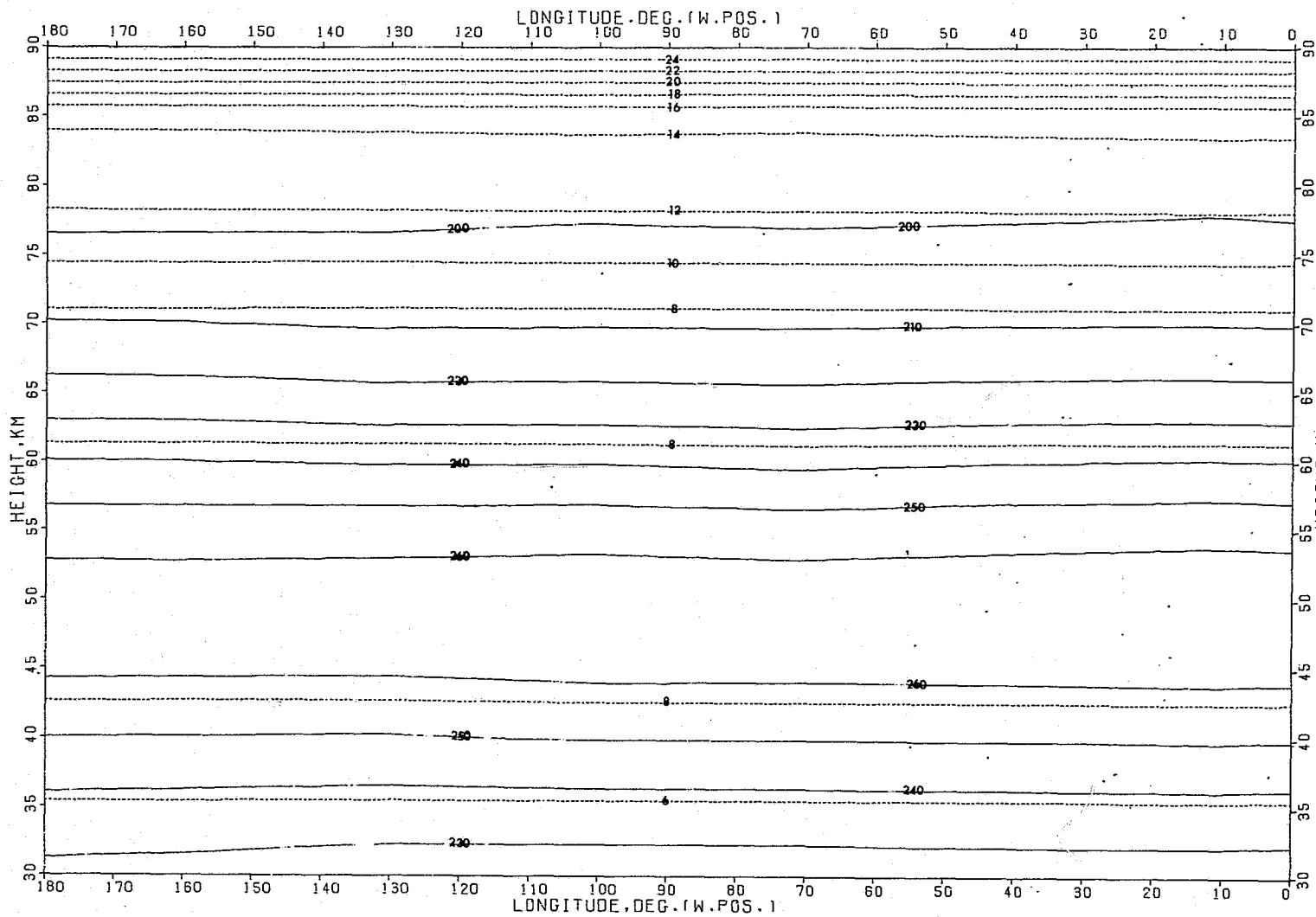


FIG 102

KFY-

--- UPPER 99TH PERCENTILE OF TEMPERATURE
 - - - LOWER 99TH PERCENTILE OF TEMPERATURE
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

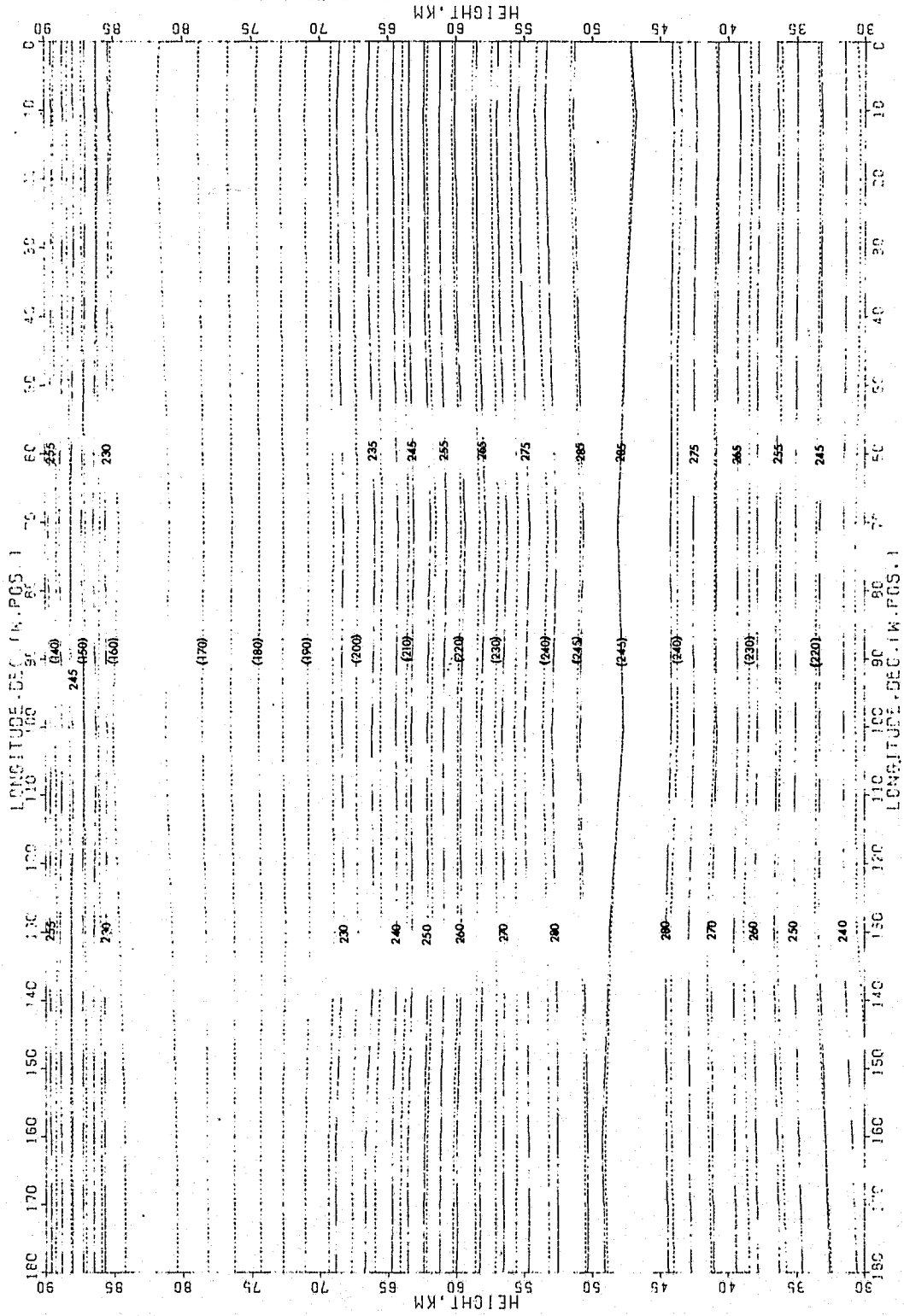


FIG 103

KEY-

— EASTWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - STD. DEV. OF EASTWARD WIND
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

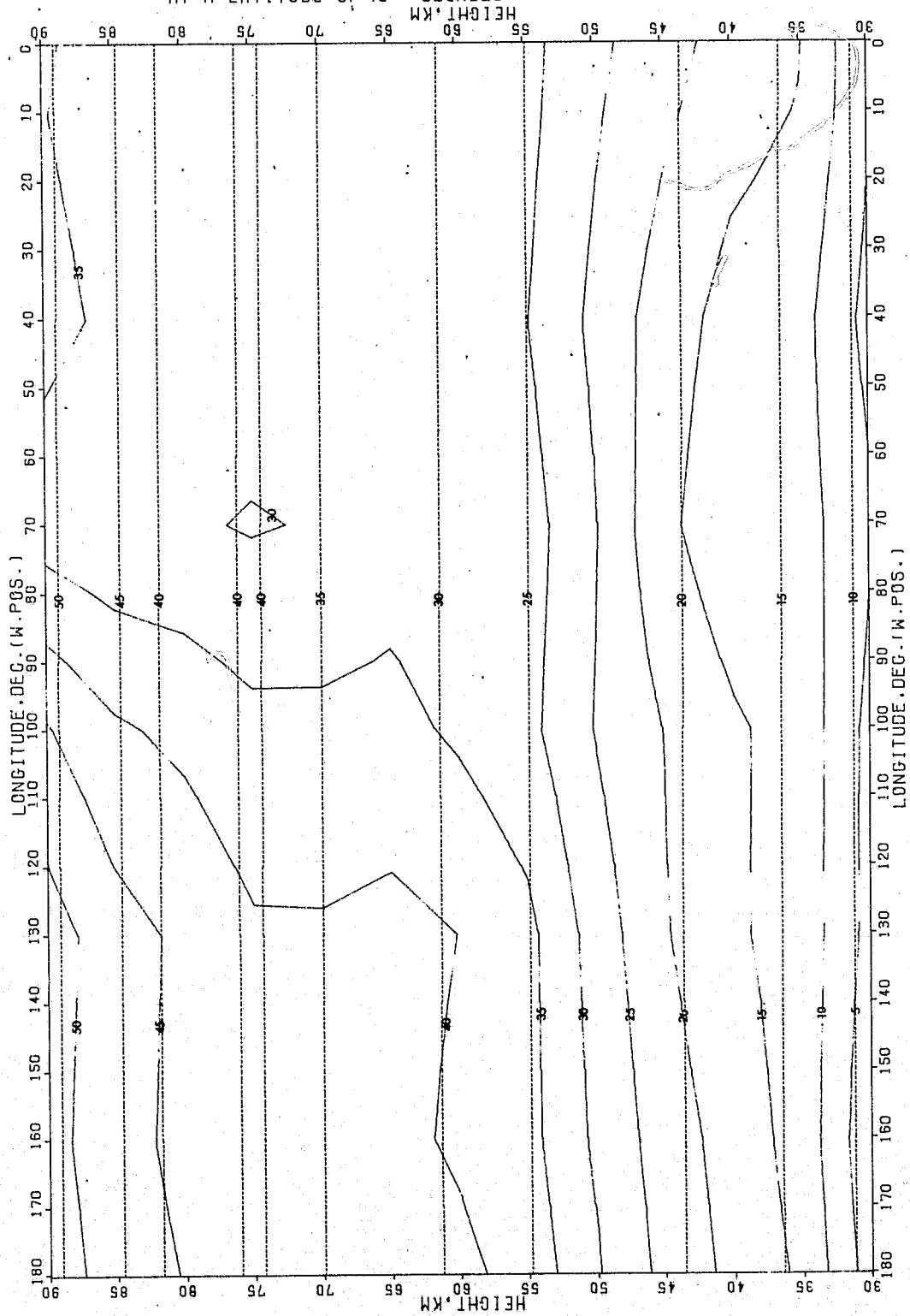


FIG 104

KEY-

—— UPPER 99TH PERCENTILE OF EASTWARD WIND
 - - - - - LOWER 99TH PERCENTILE OF EASTWARD WIND
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

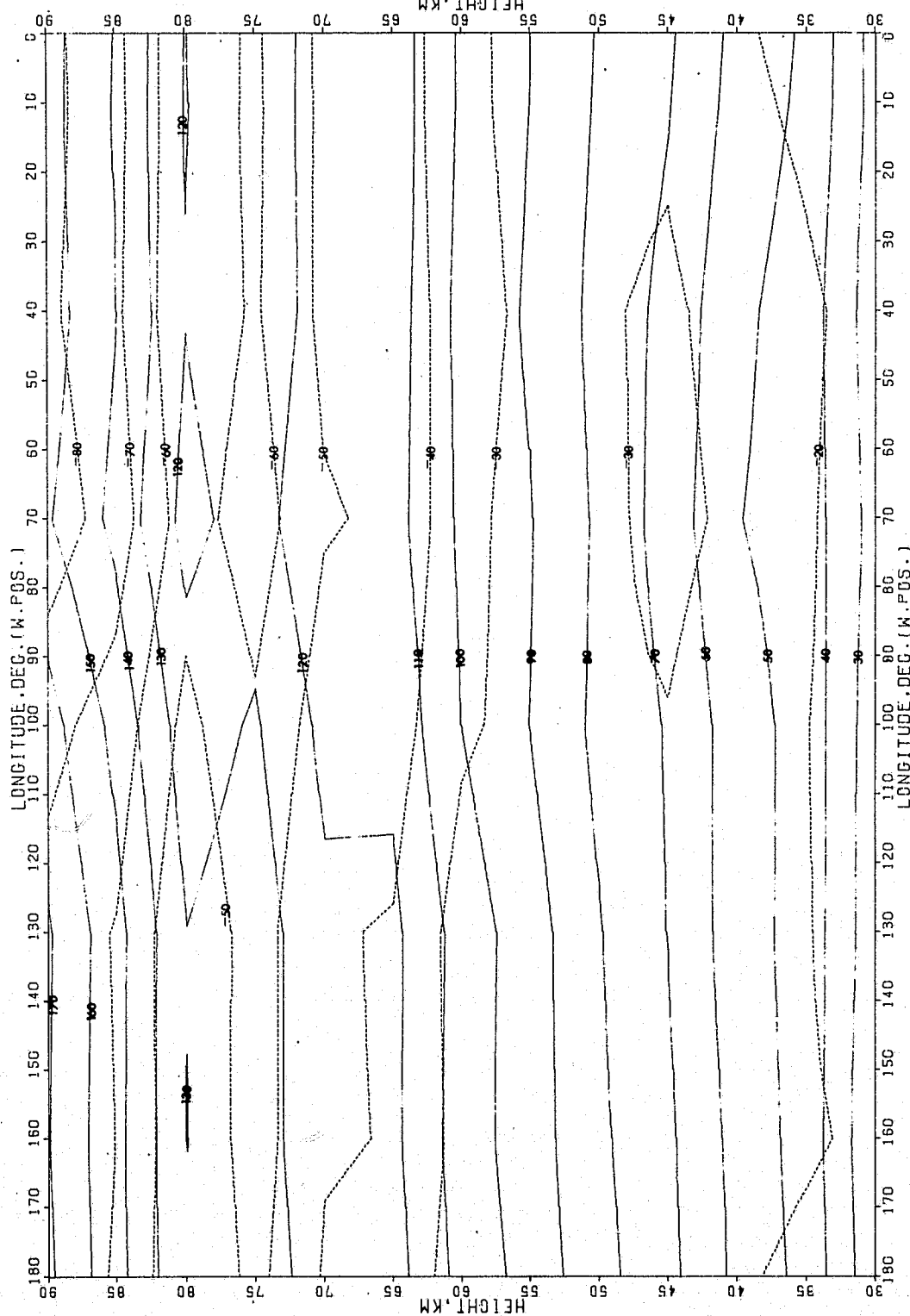


FIG 105

KEY-

— NORTHWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - - - - - STD. DEV. OF NORTHWARD WIND
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

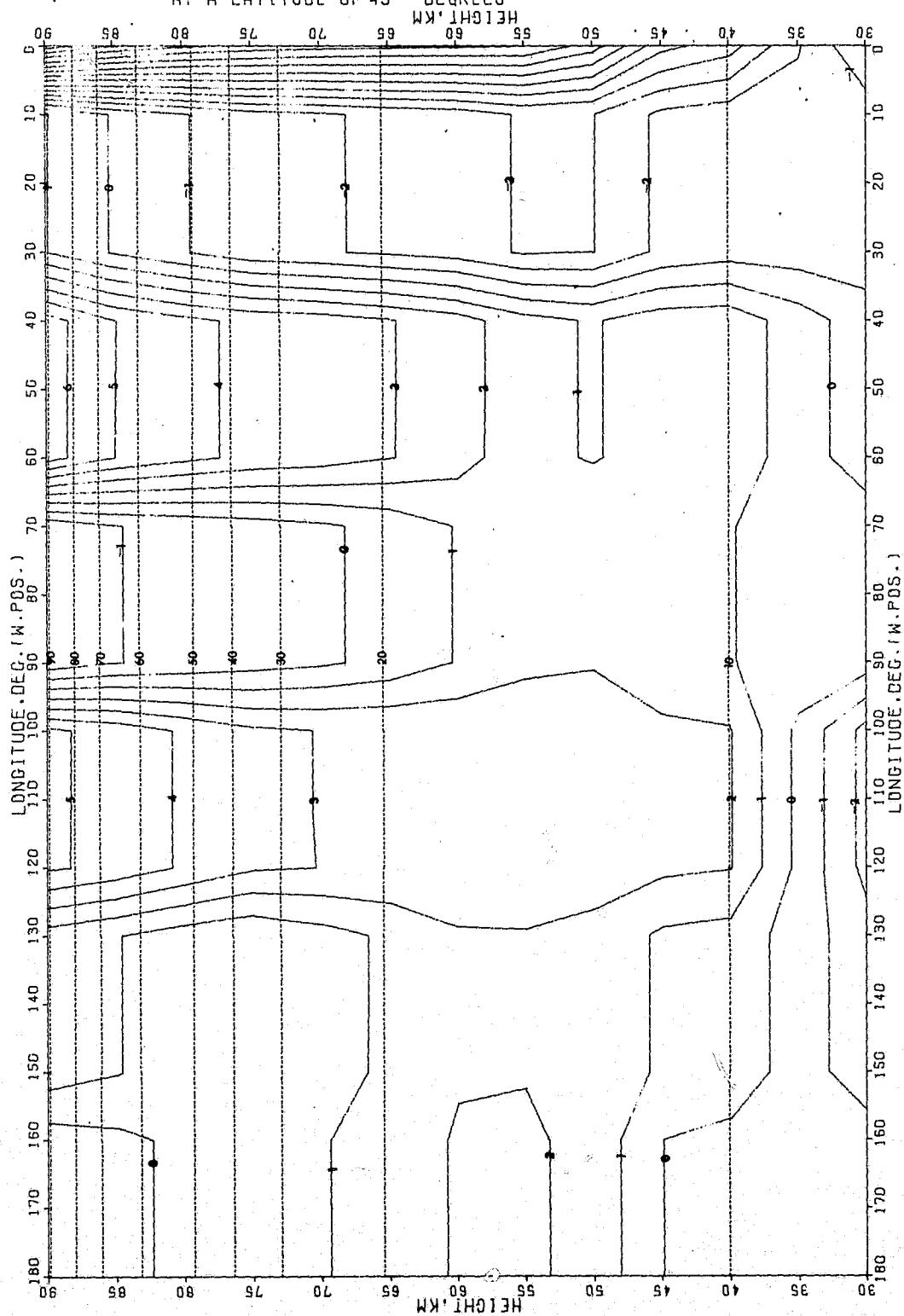


FIG 106

KEY-

----- UPPER 99TH PERCENTILE OF NORTHWARD WIND
 ----- LOWER 99TH PERCENTILE OF NORTHWARD WIND
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

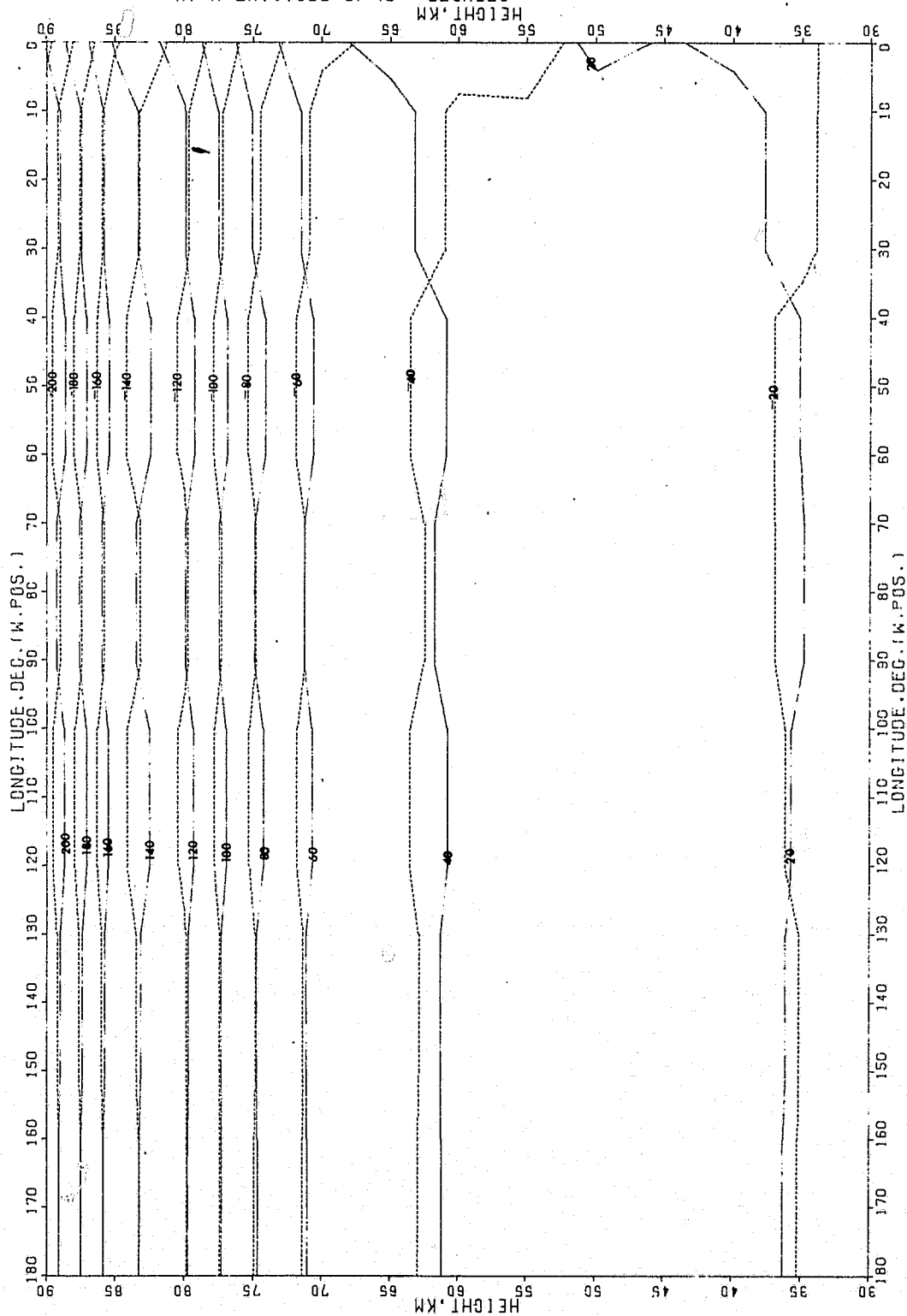


FIG 107

KEY-

— WIND SPEED M/S
 - - - - - STD. DEV. OF WIND SPEED
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

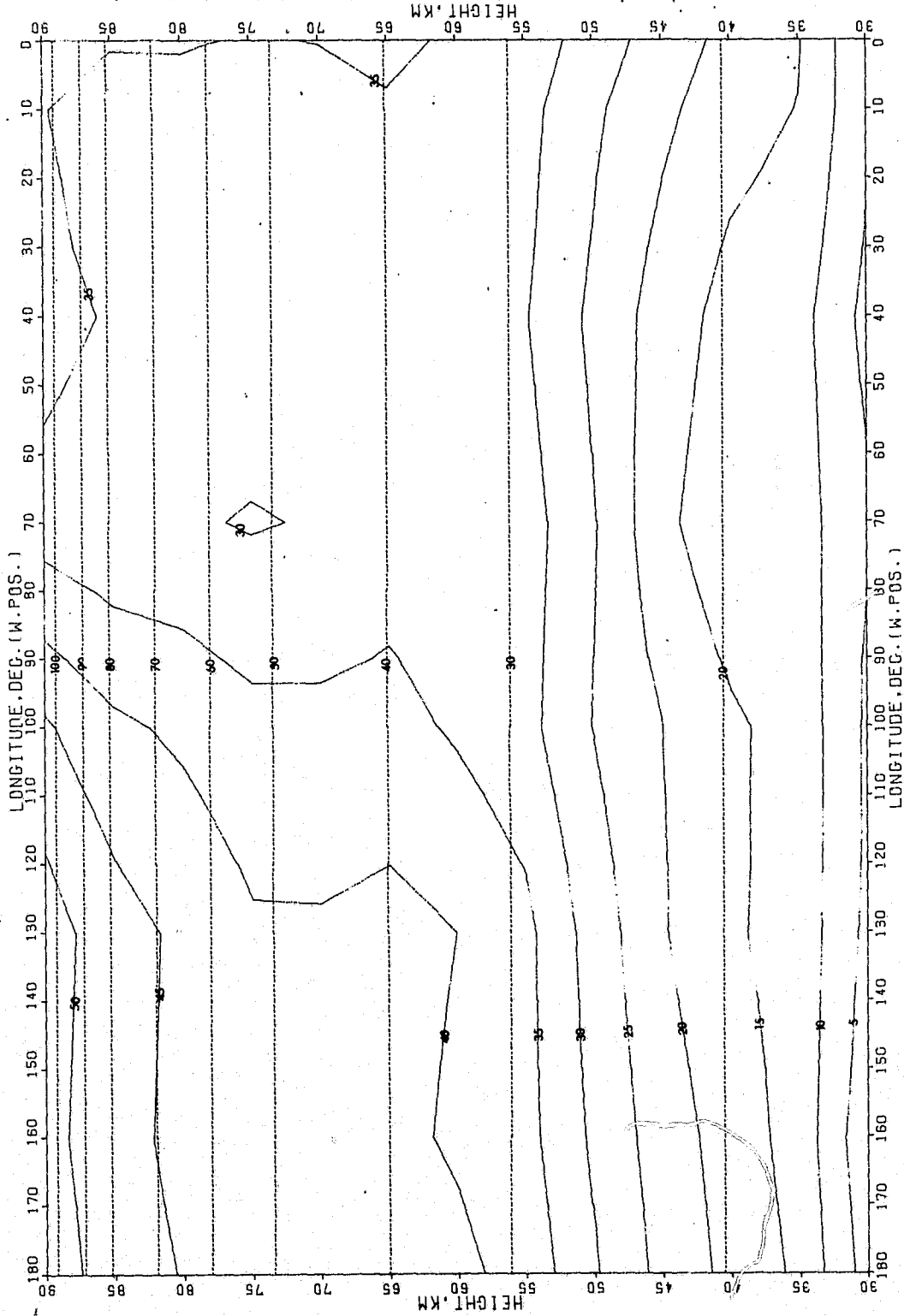


FIG 108

KEY-

—— UPPER 99TH PERCENTILE OF WIND SPEED
 LOWER 99TH PERCENTILE OF WIND SPEED
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

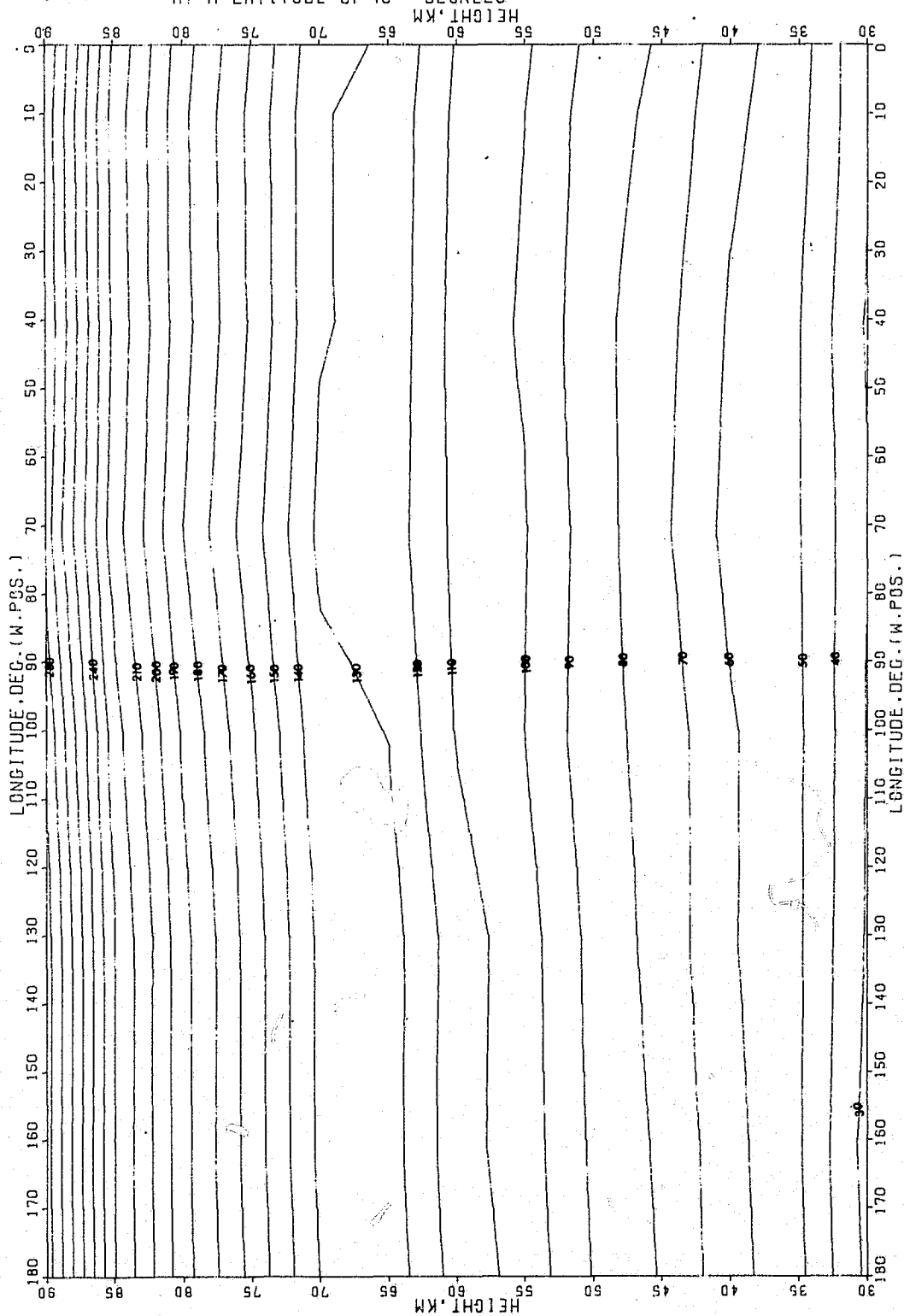


FIG 109

KEY

——— PRESSURE, PER CENT DEV. FROM STD. ATM.
 - - - - - STD. DEV. OF PRESSURE
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

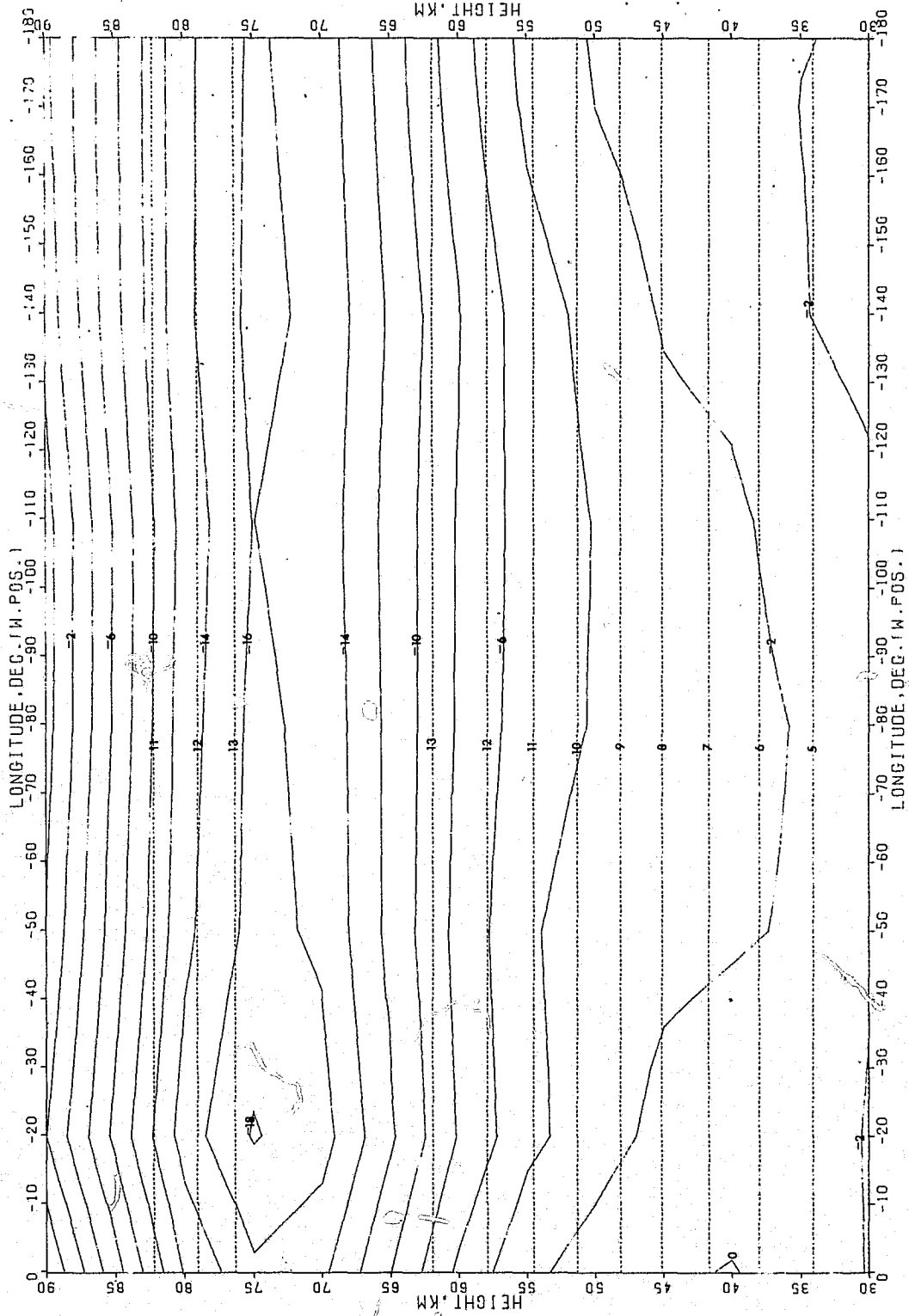


FIG 110

KEY-

—— UPPER 99TH PERCENTILE OF PRESSURE
 LOWER 99TH PERCENTILE OF PRESSURE
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

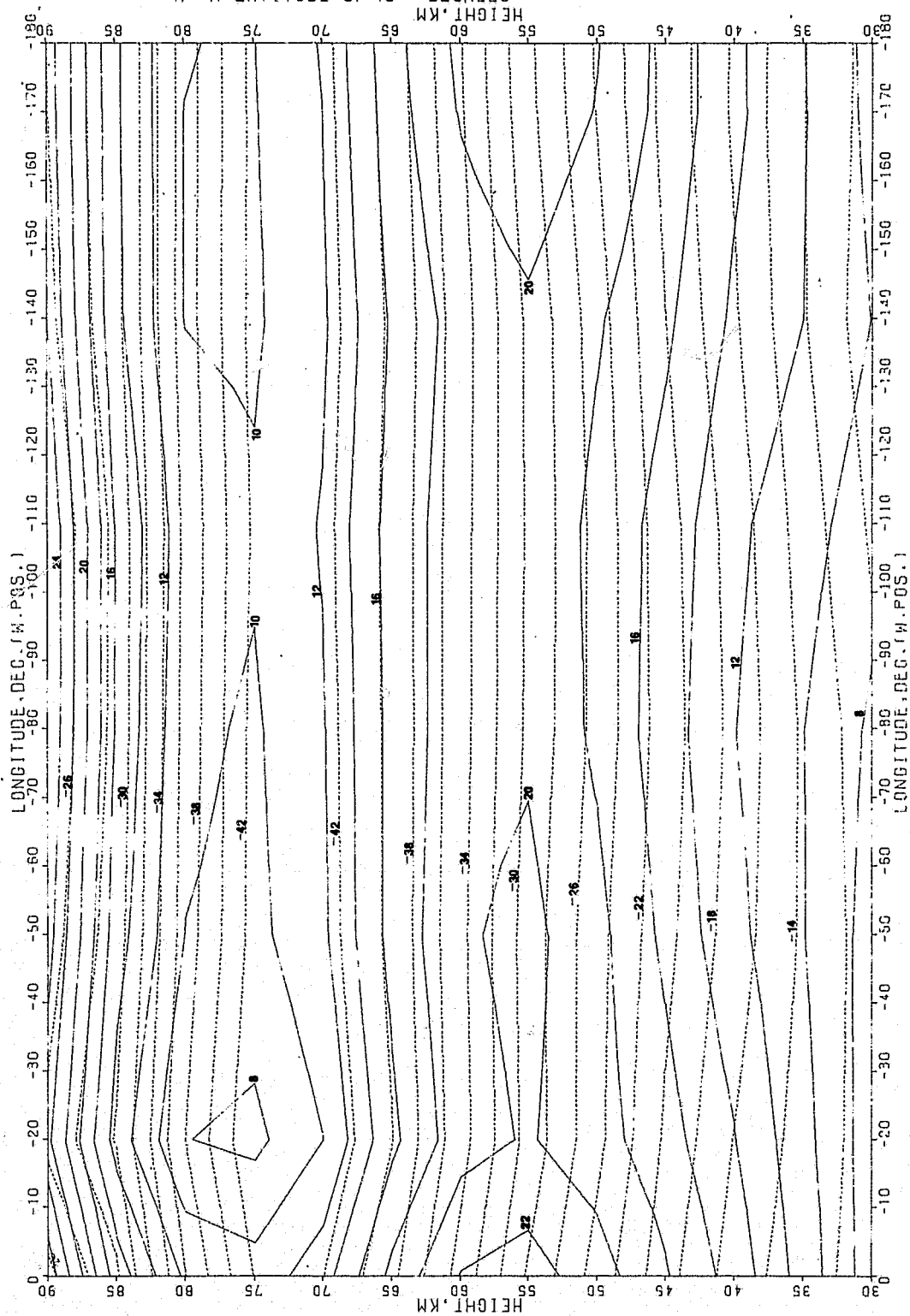


FIG 111

KEY-

— DENSITY, PER CENT DEV. FROM STD. ATM.
 - - - - - STD. DEV., OF DENSITY
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

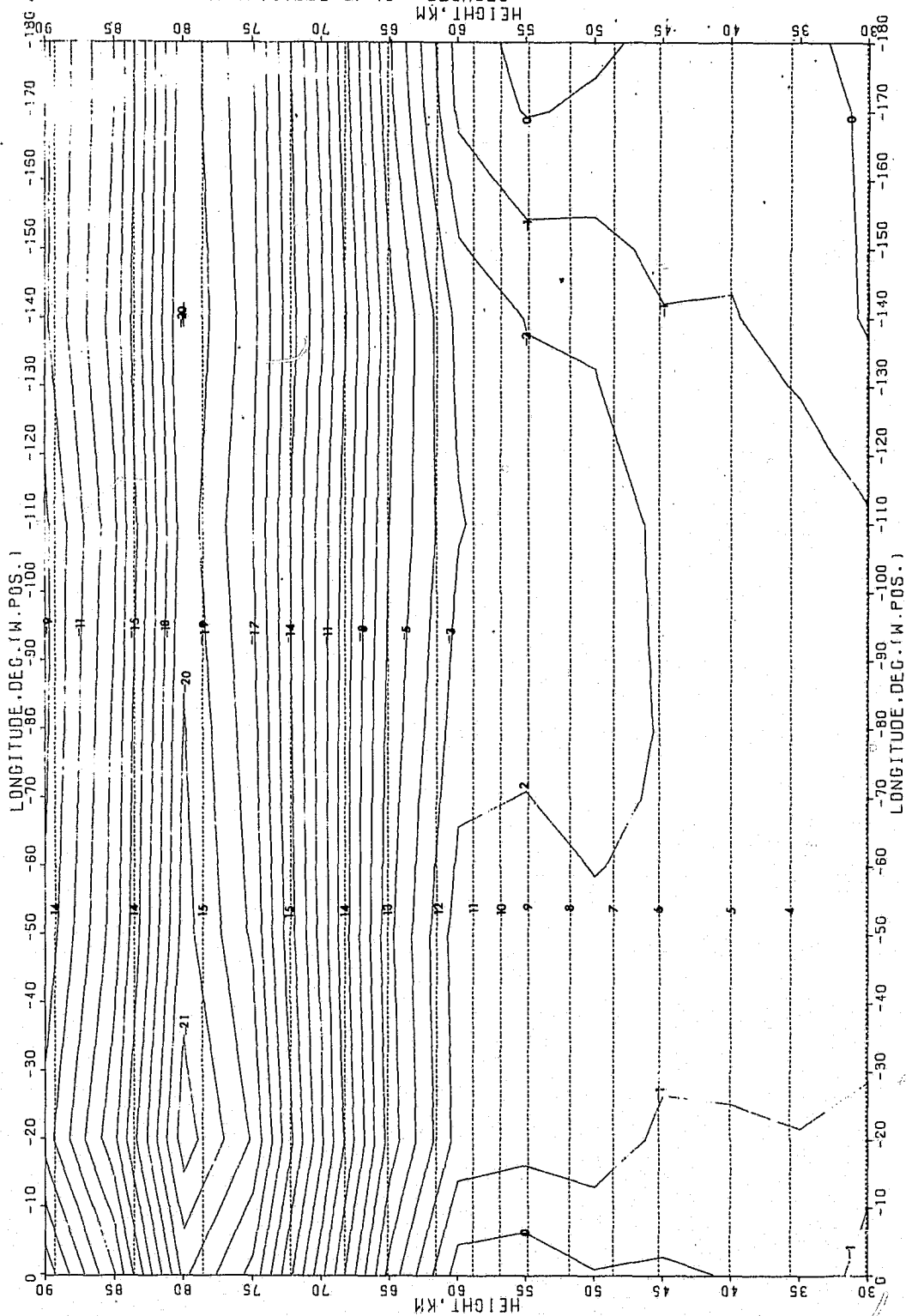
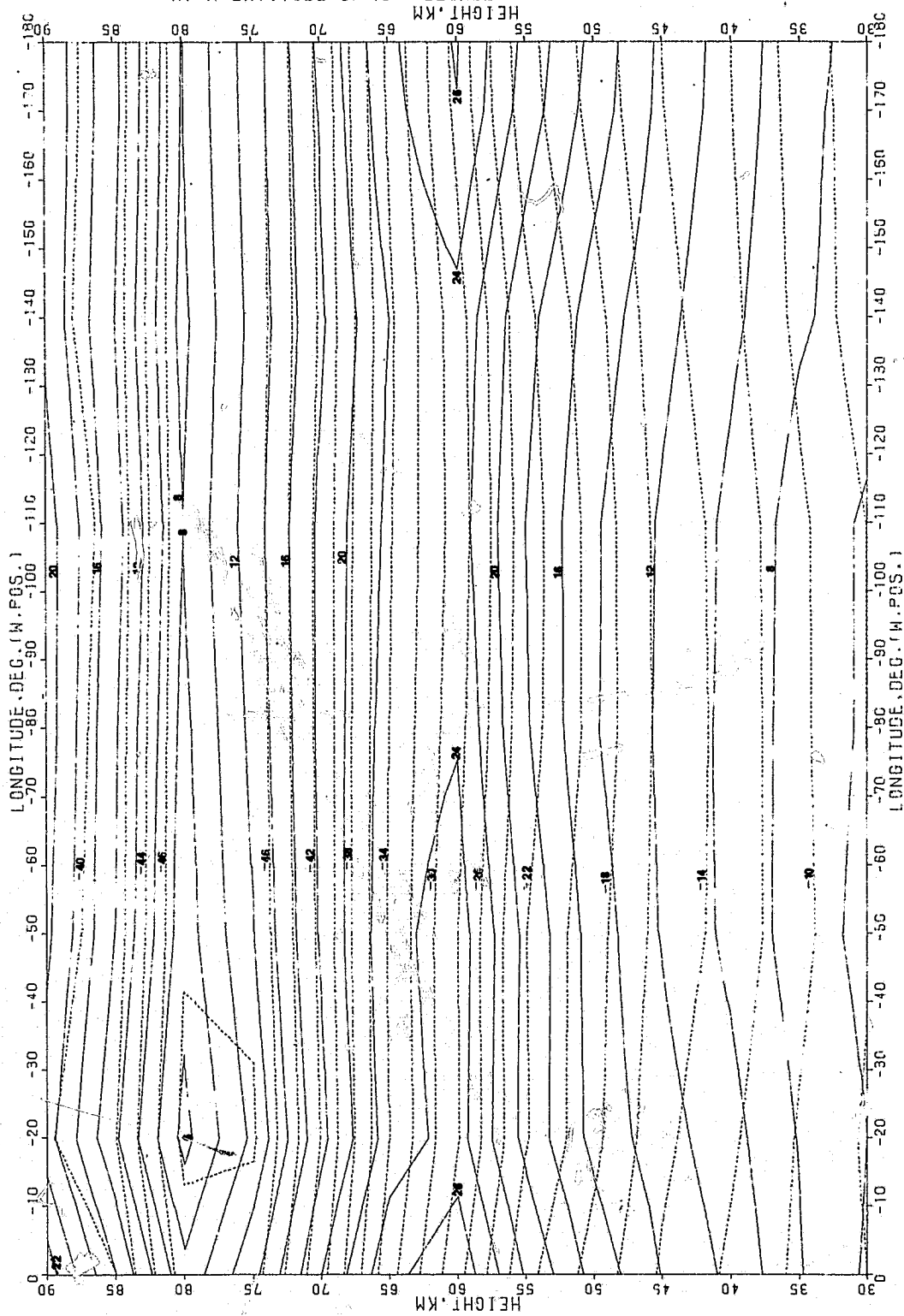


FIG 112

KEY-
 ——— UPPER 99TH PERCENTILE OF DENSITY
 - - - - - LOWER 99TH PERCENTILE OF DENSITY
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES



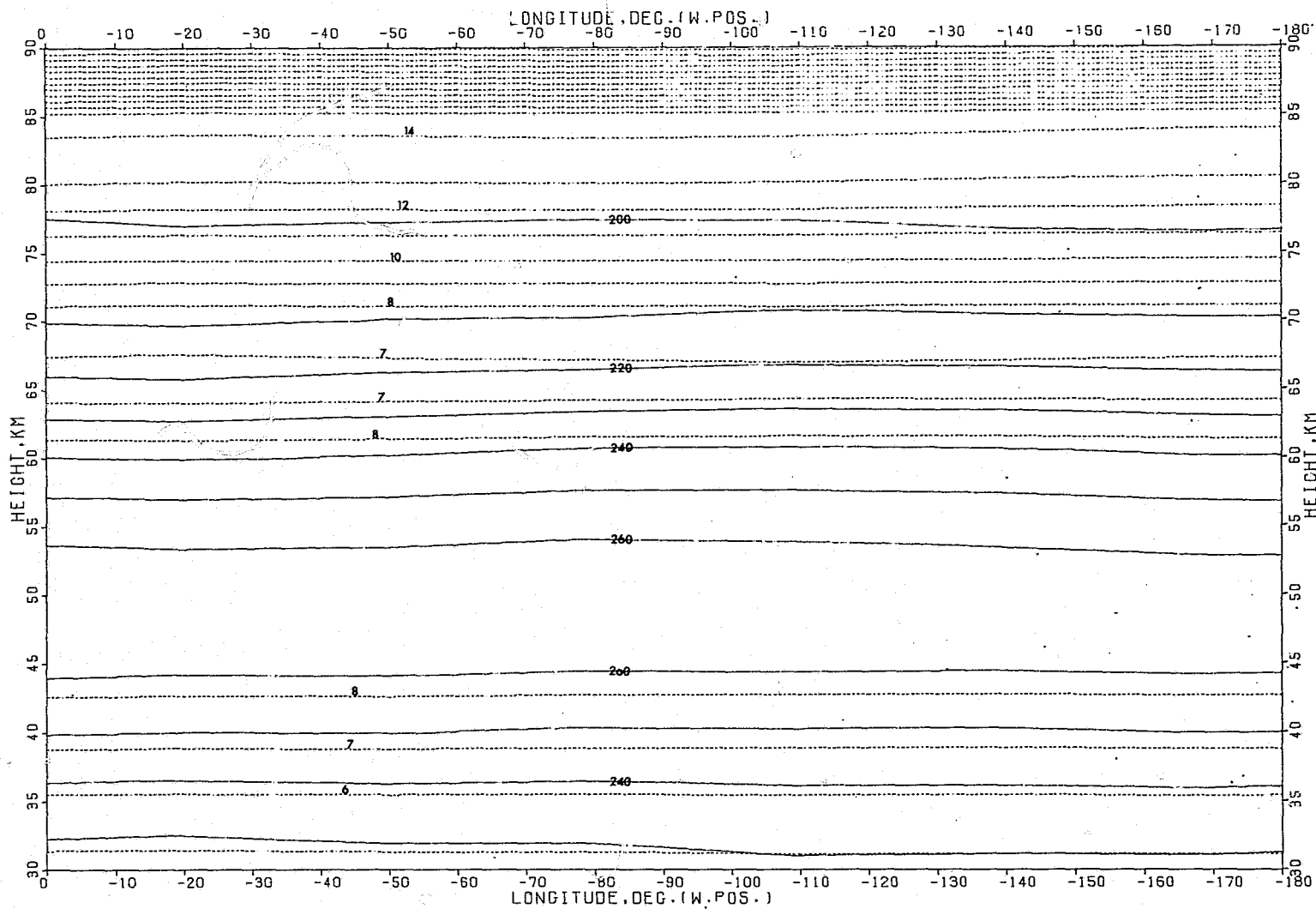


FIG 114

KEY-

—— UPPER 99TH PERCENTILE OF TEMPERATURE
 - - - - LOWER 99TH PERCENTILE OF TEMPERATURE
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

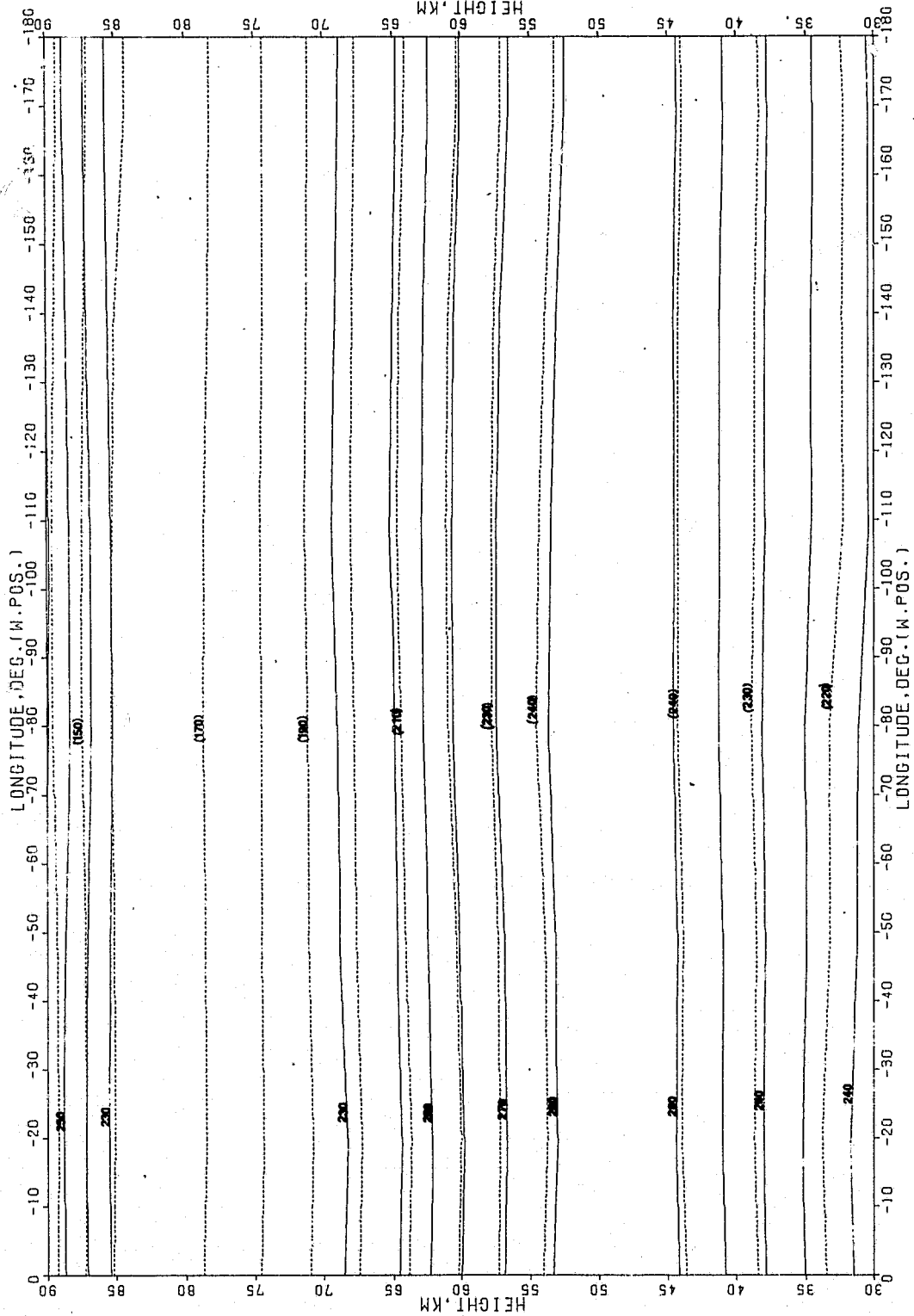


FIG 115

KEY-

- EASTWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 - STD. DEV. OF EASTWARD WIND
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

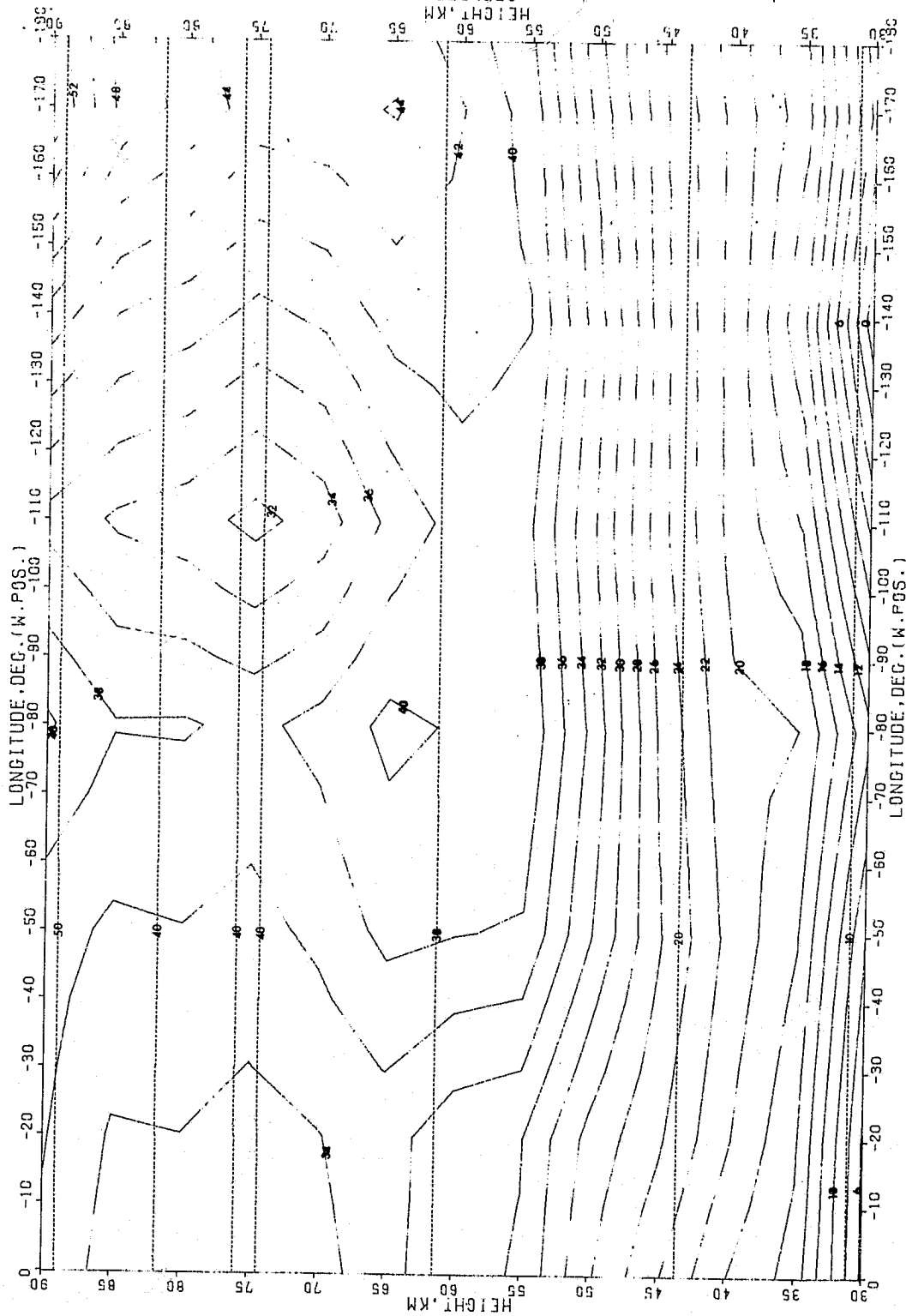


FIG 116

KEY-

----- UPPER 99TH PERCENTILE OF EASTWARD WIND
 ----- LOWER 99TH PERCENTILE OF EASTWARD WIND
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

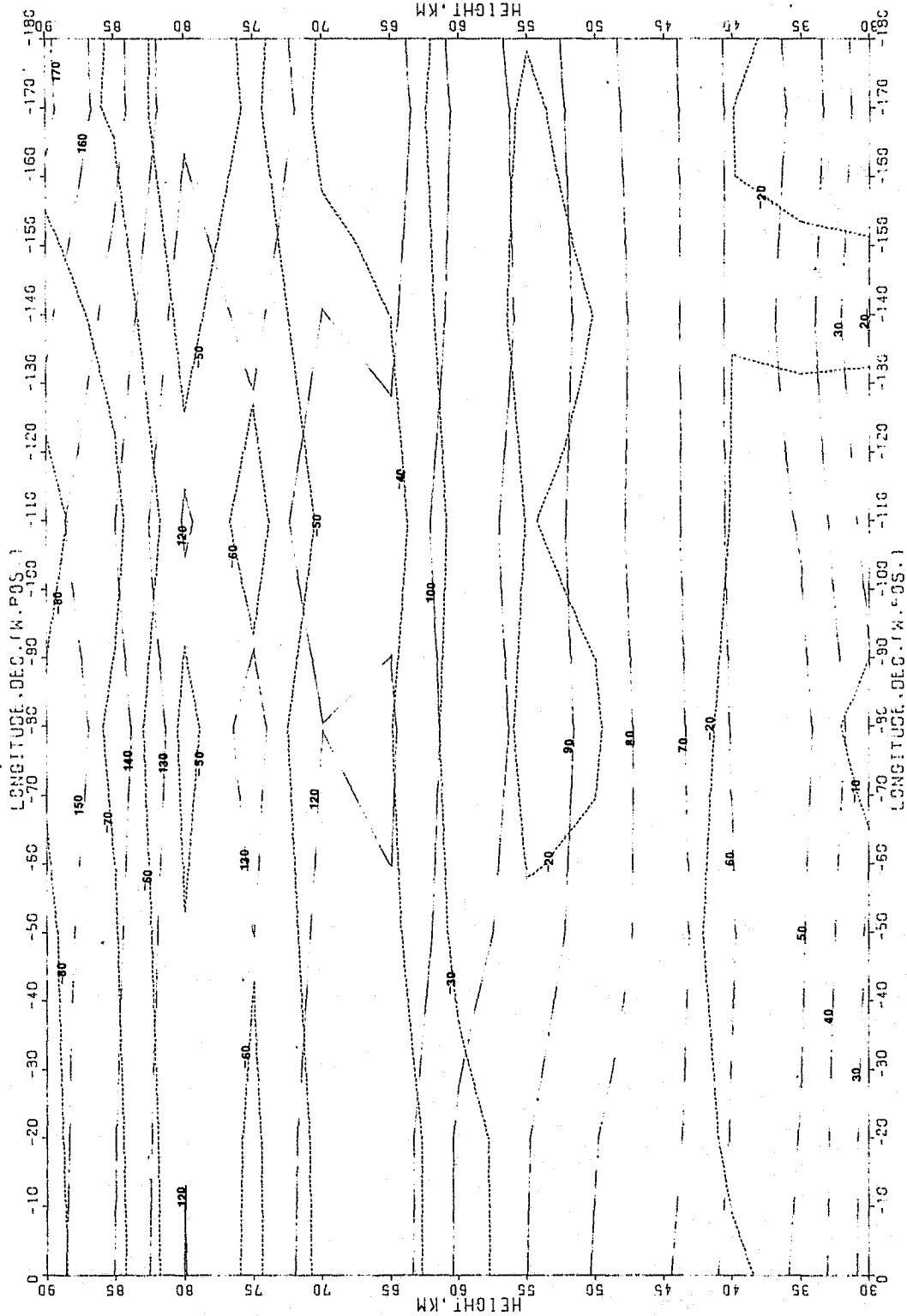
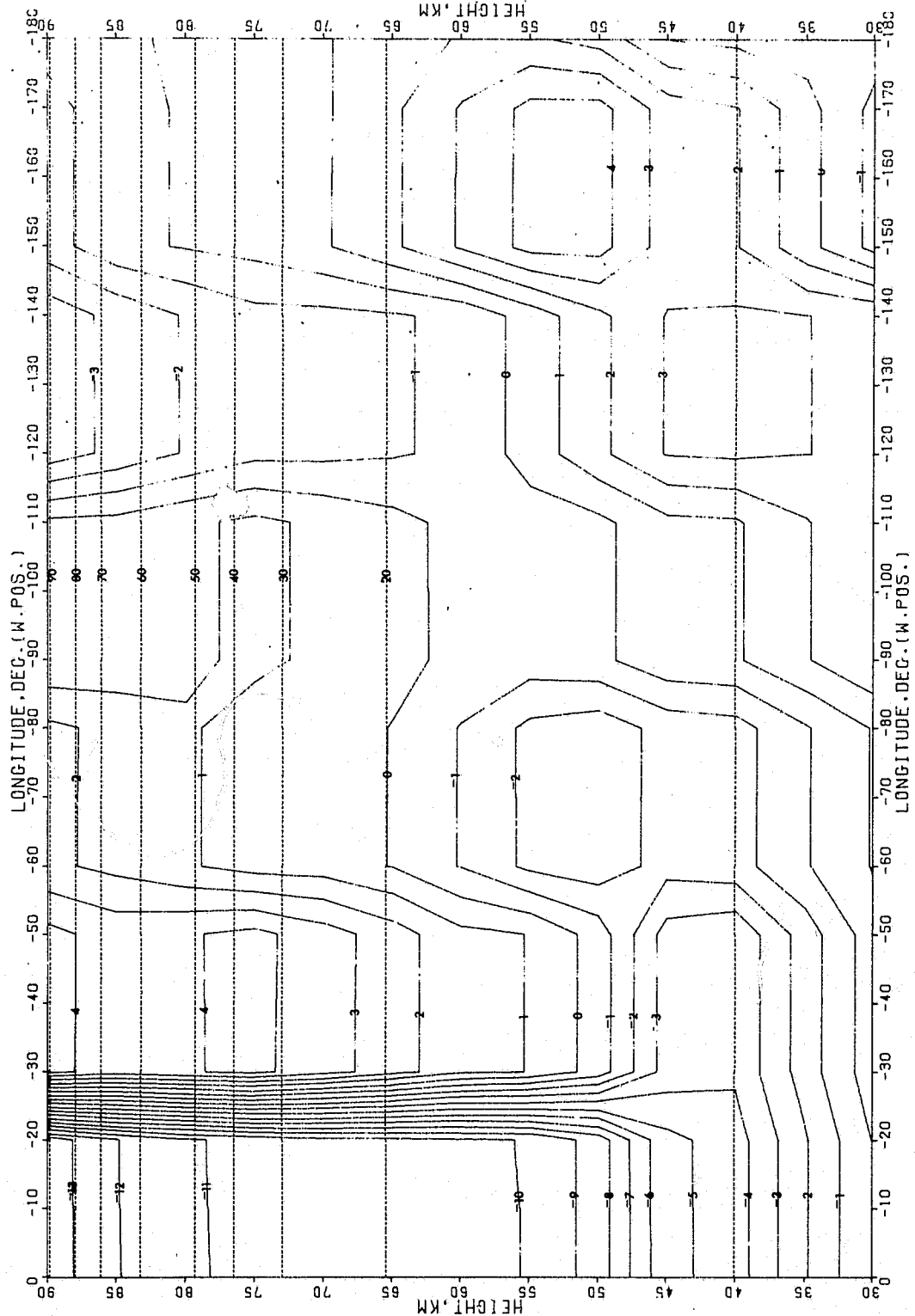


FIG 117

KEY-

--- NORTHWARD WIND, GEOSTROPIC MONTHLY MEAN M/S
 STD. DEV. OF NORTHWARD WIND
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

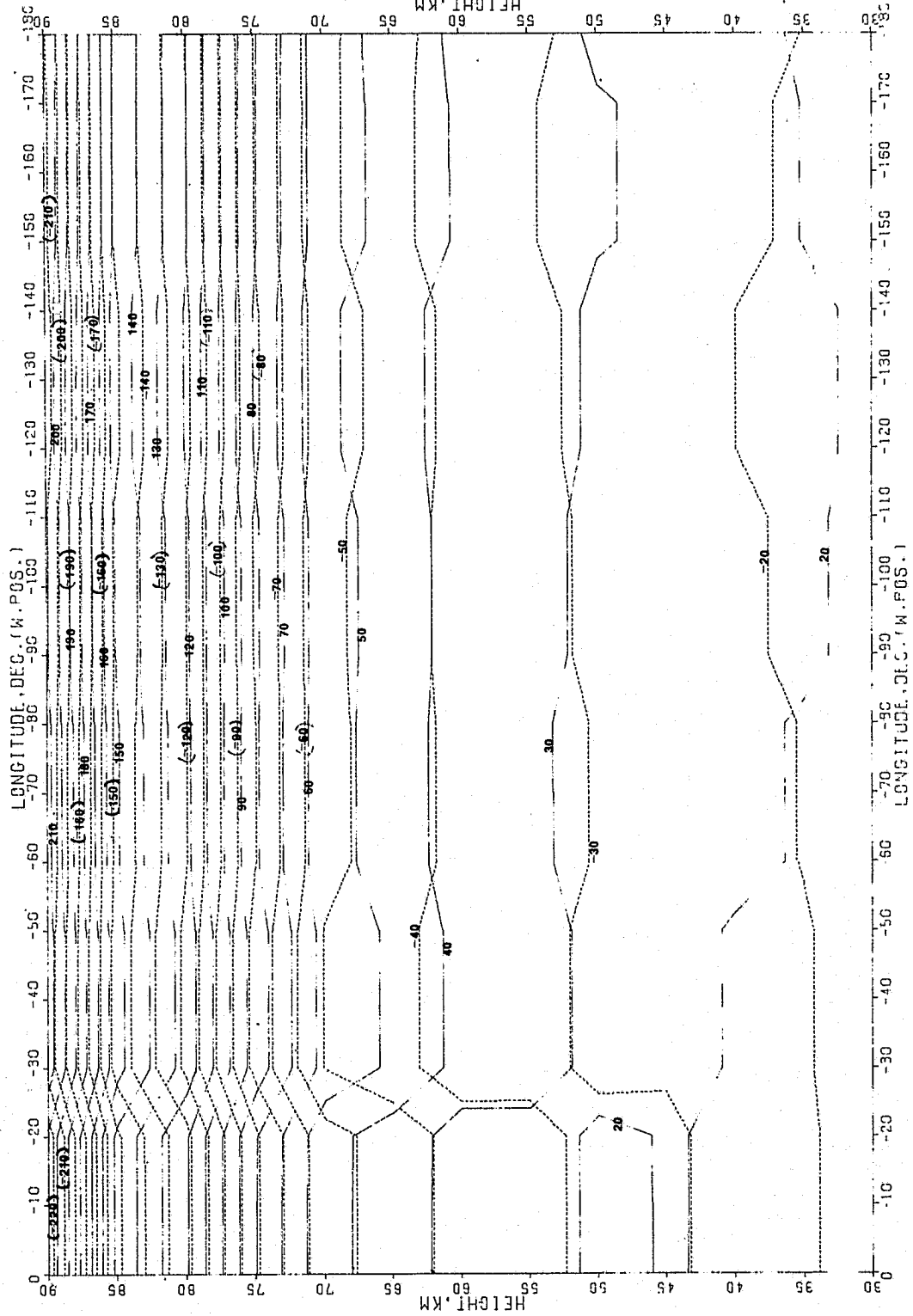


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FIG 118

KEY -

UPPER 99TH PERCENTILE OF NORTHWARD WIND
 LOWER 99TH PERCENTILE OF NORTHWARD WIND
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES



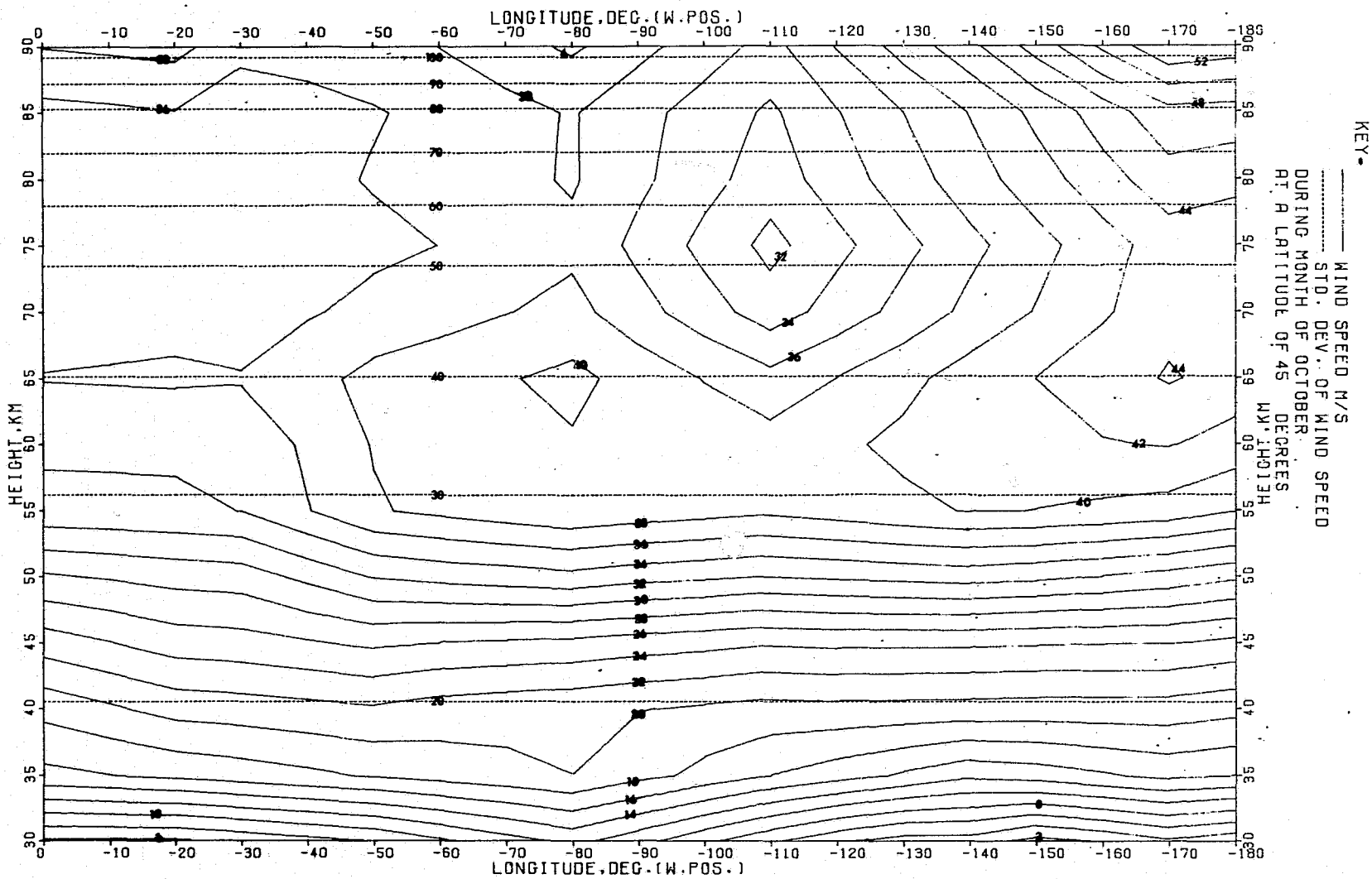


FIG 119

FIG 120

KEY-

—— UPPER 99TH PERCENTILE OF WIND SPEED
 - - - - - LOWER 99TH PERCENTILE OF WIND SPEED
 DURING MONTH OF OCTOBER
 AT A LATITUDE OF 45 DEGREES

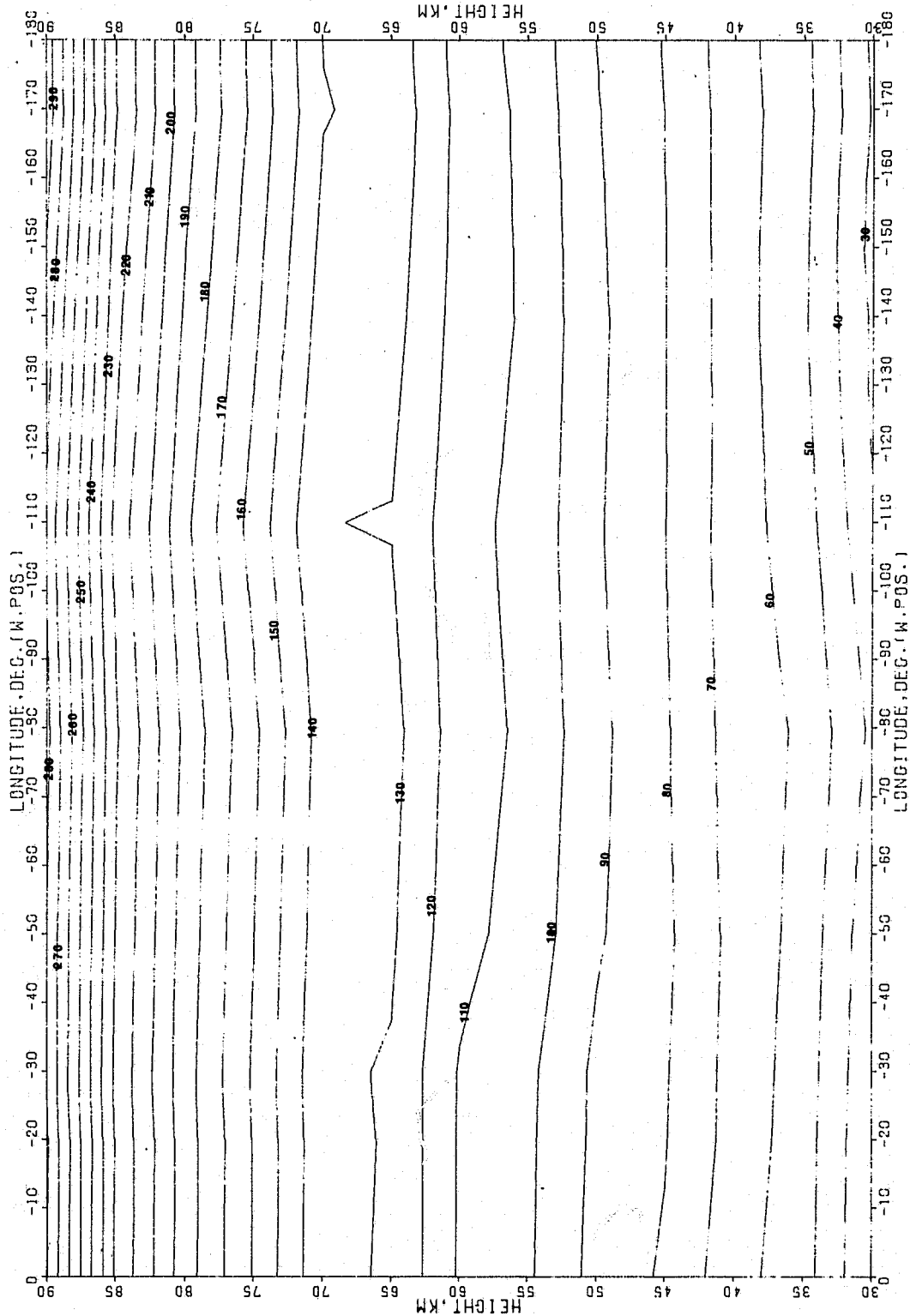
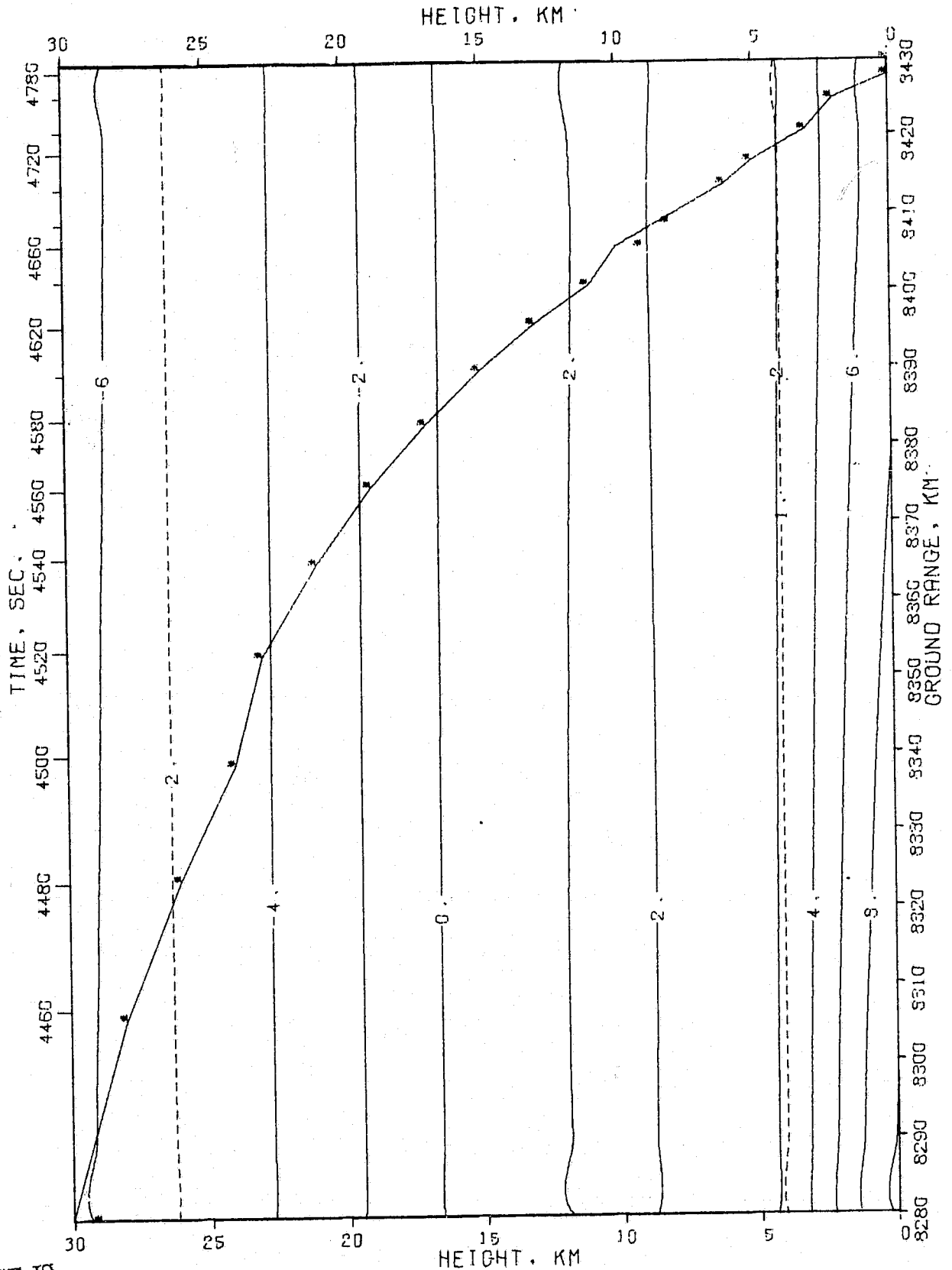


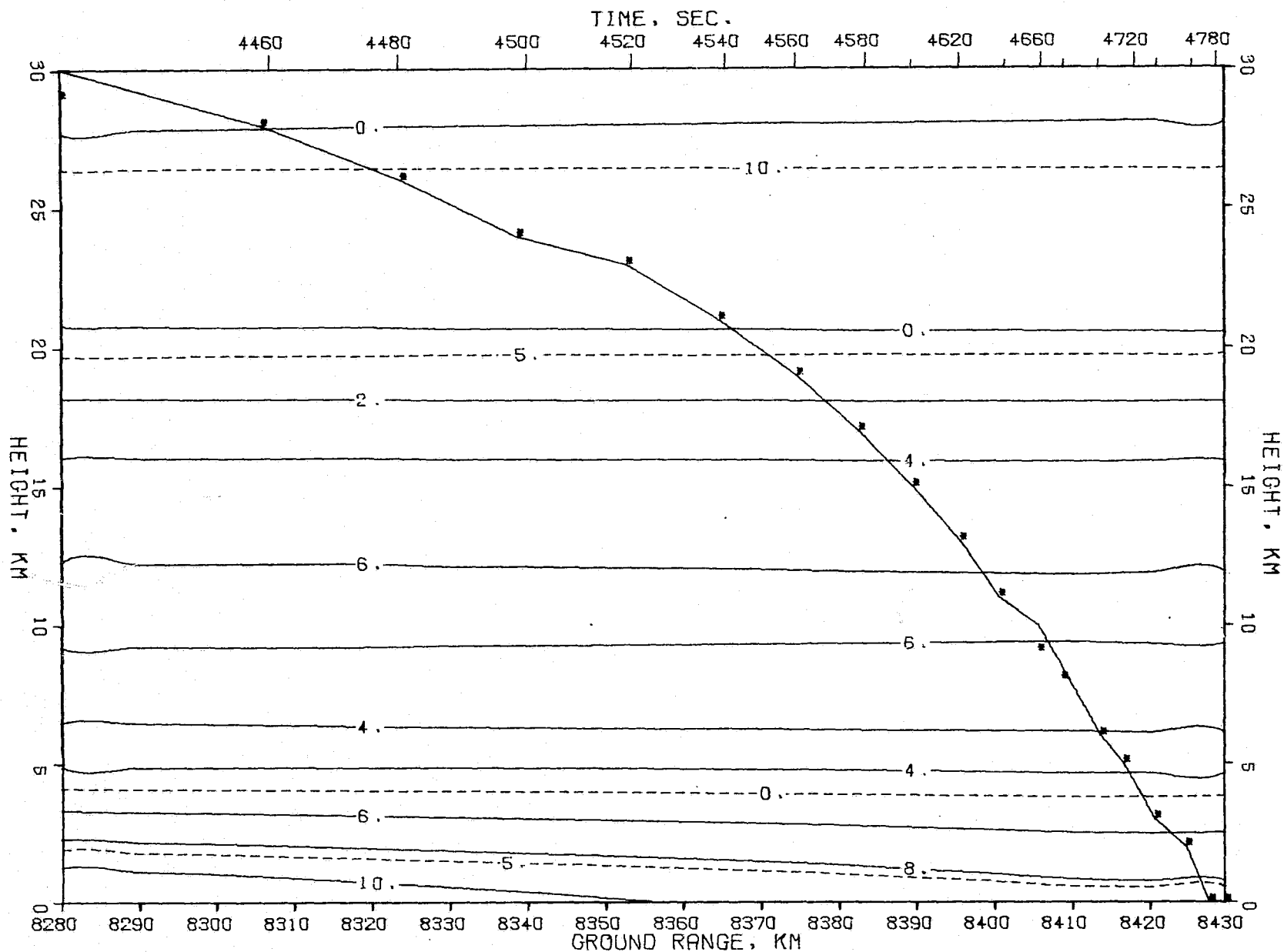
FIG 121

KEY

- PRESSURE, PERCENT DEV. FROM STD. ATM.
- - - STD. DEV. OF PRESSURE
- TRAJECTORY
- DURING MONTH OF JANUARY



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KEY

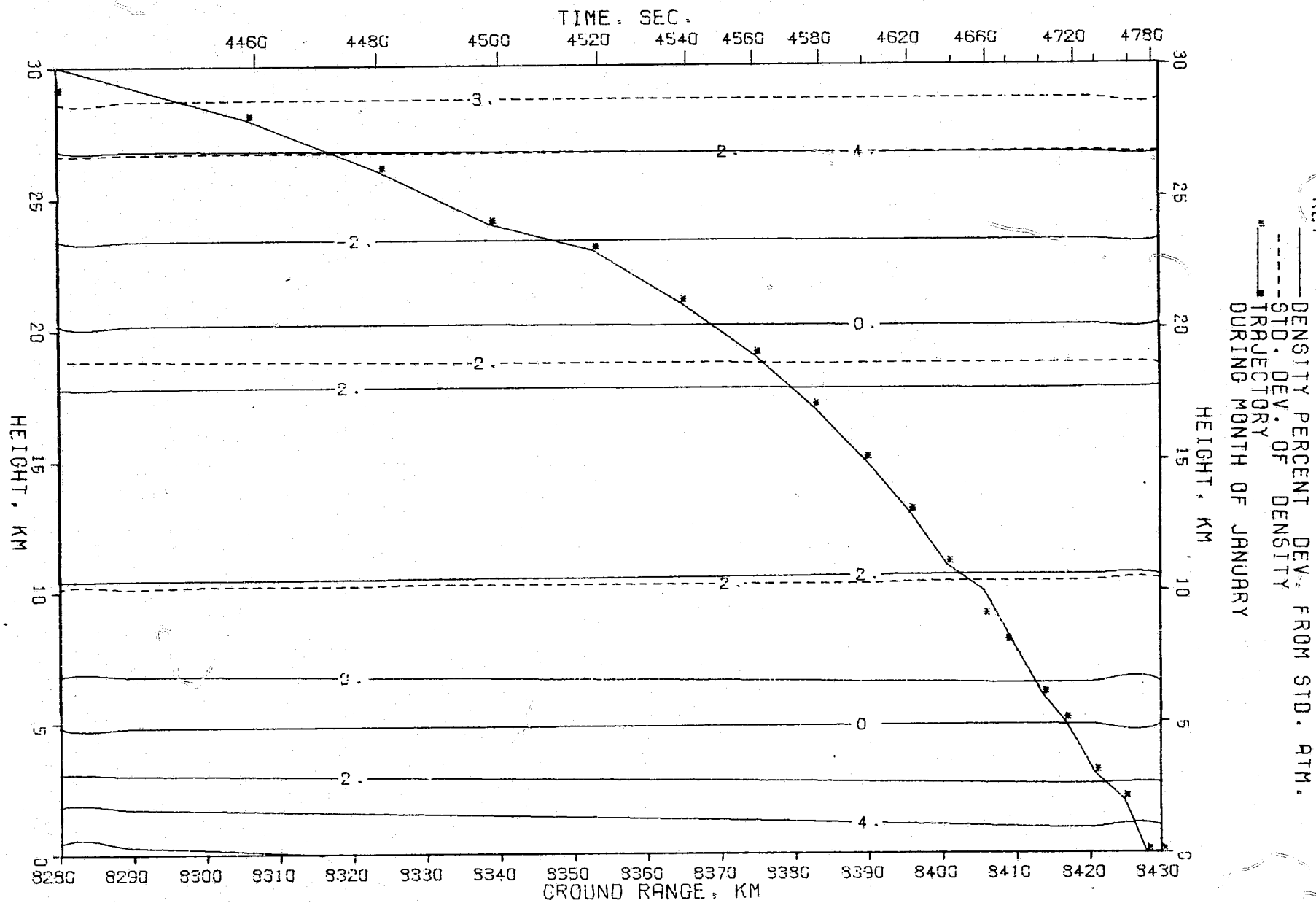
— UPPER 99TH PERCENTILE OF PRESSURE

--- LOWER 99TH PERCENTILE OF PRESSURE

■ TRAJECTORY

DURING MONTH OF JANUARY

FIG 122



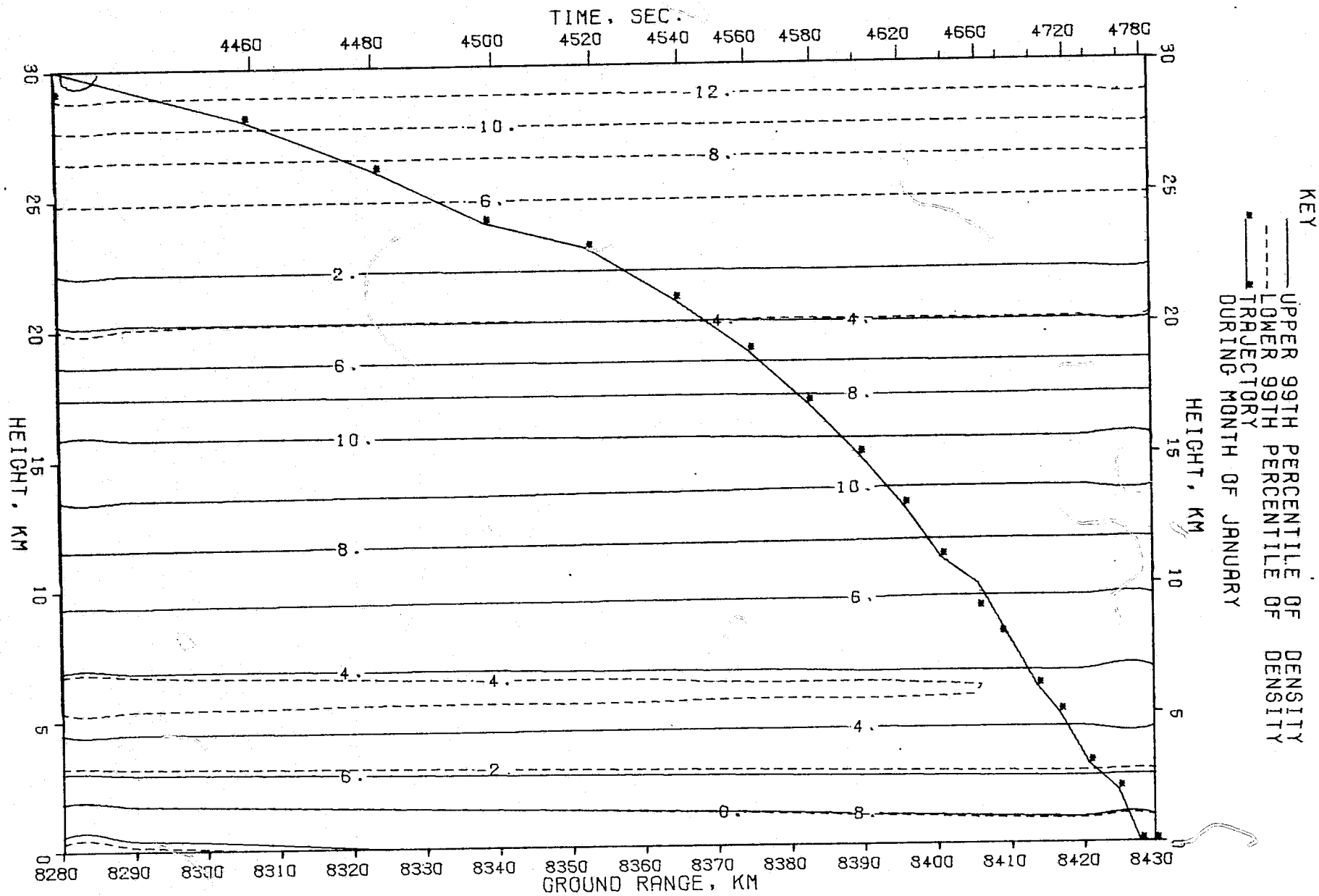


FIG 124

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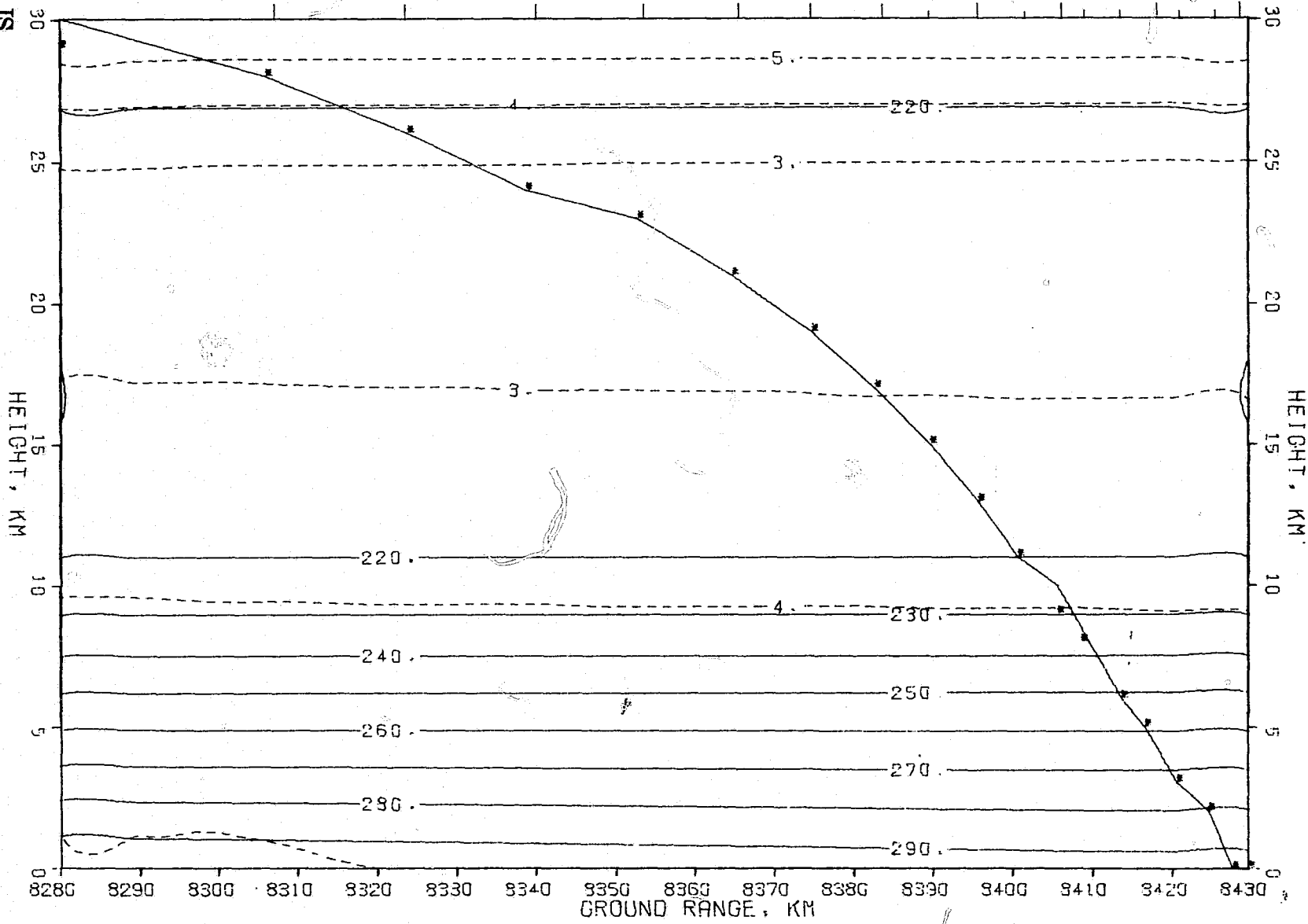
TIME, SEC.

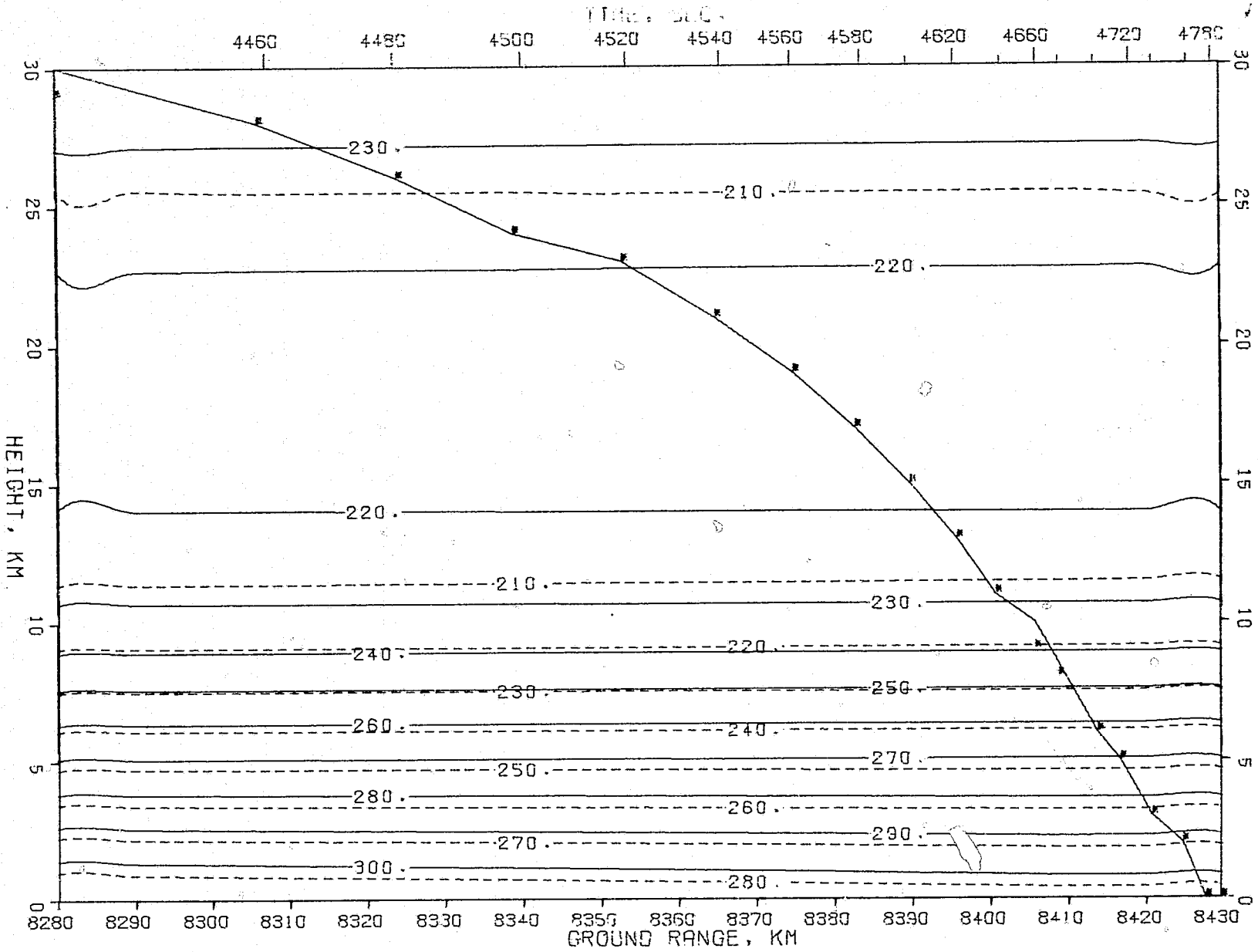
4460 4480 4500 4520 4540 4560 4580 4620 4660 4720 4780

KEY

— TEMPERATURE DEG. K
- - - STD. DEV. OF TEMPERATURE
* TRAJECTORY
DURING MONTH OF JANUARY

FIG 125





KEY

— UPPER 99TH PERCENTILE OF TEMPERATURE

- - - LOWER 99TH PERCENTILE OF TEMPERATURE

— TRAJECTORY

DURING MONTH OF JANUARY

FIG 126

FIG 127

KEY

- EASTWARD WIND GEOSTROPHIC MONTHLY MEAN, M/S.
- - - STD. DEV. OF EASTWARD WIND
- * — TRAJECTORY
- DURING MONTH OF JANUARY

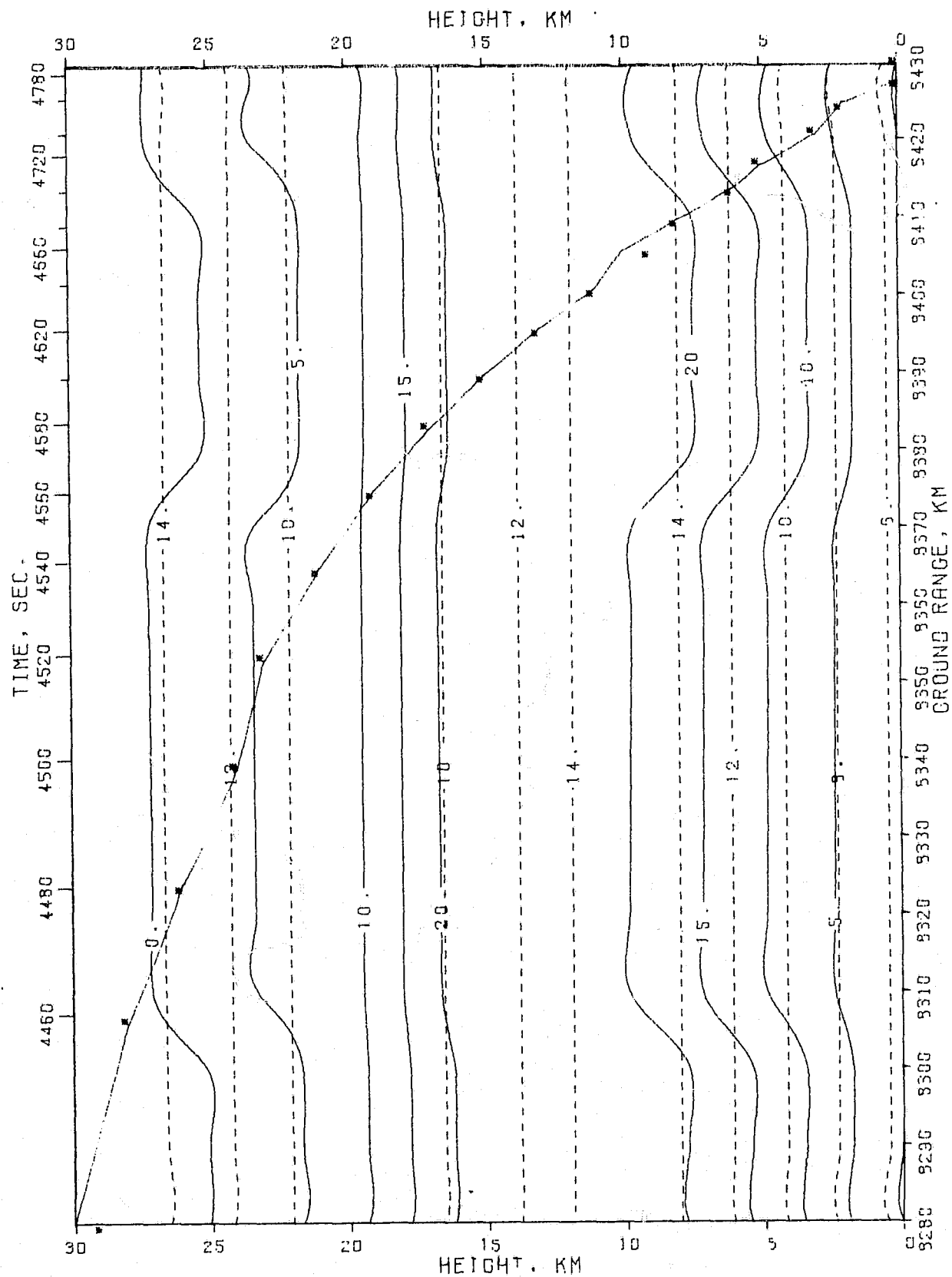


FIG 128

KEY

- UPPER 99TH PERCENTILE OF EASTWARD WIND
- - - LOWER 99TH PERCENTILE OF EASTWARD WIND
- * — TRAJECTORY
- DURING MONTH OF JANUARY

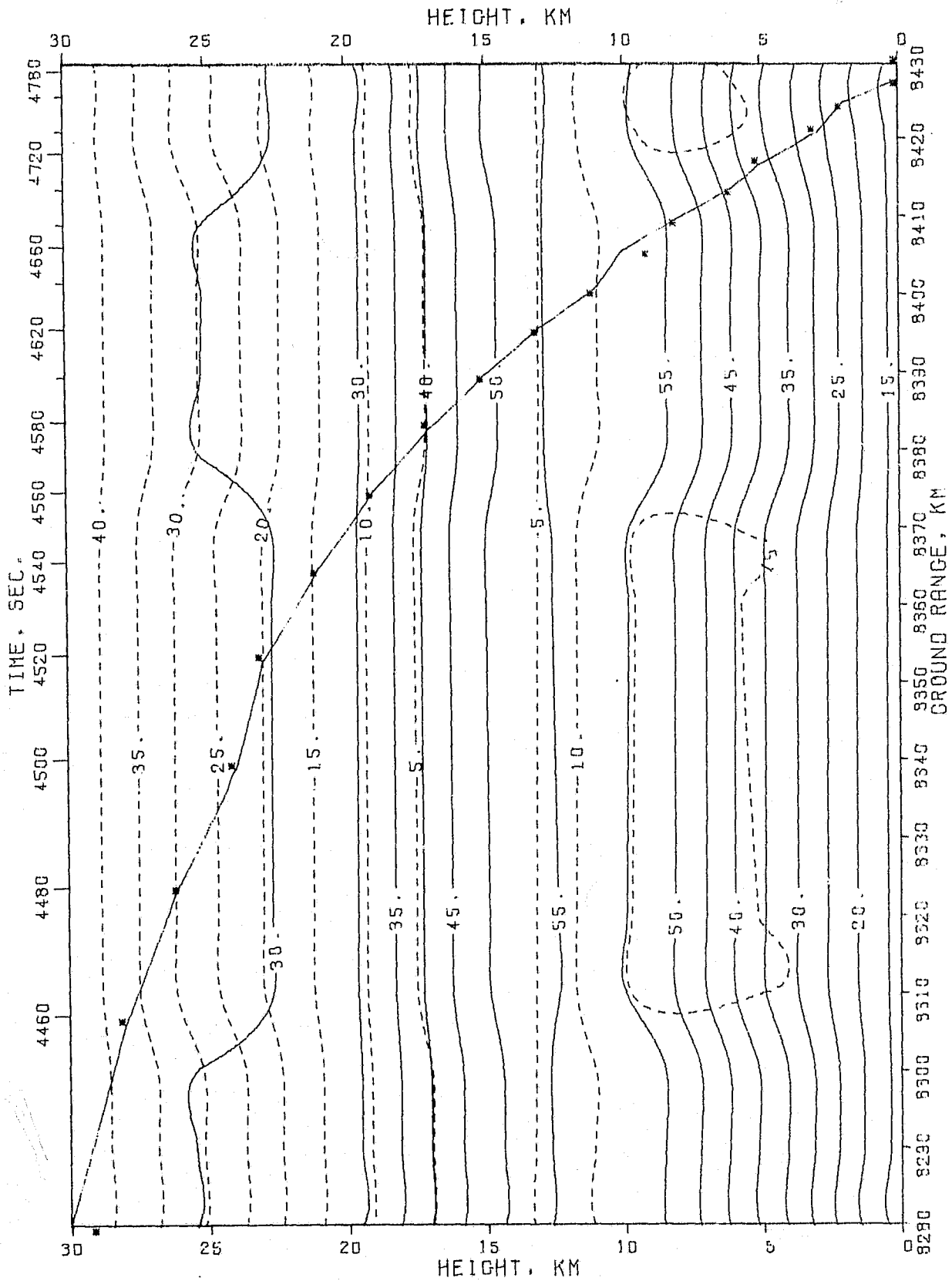
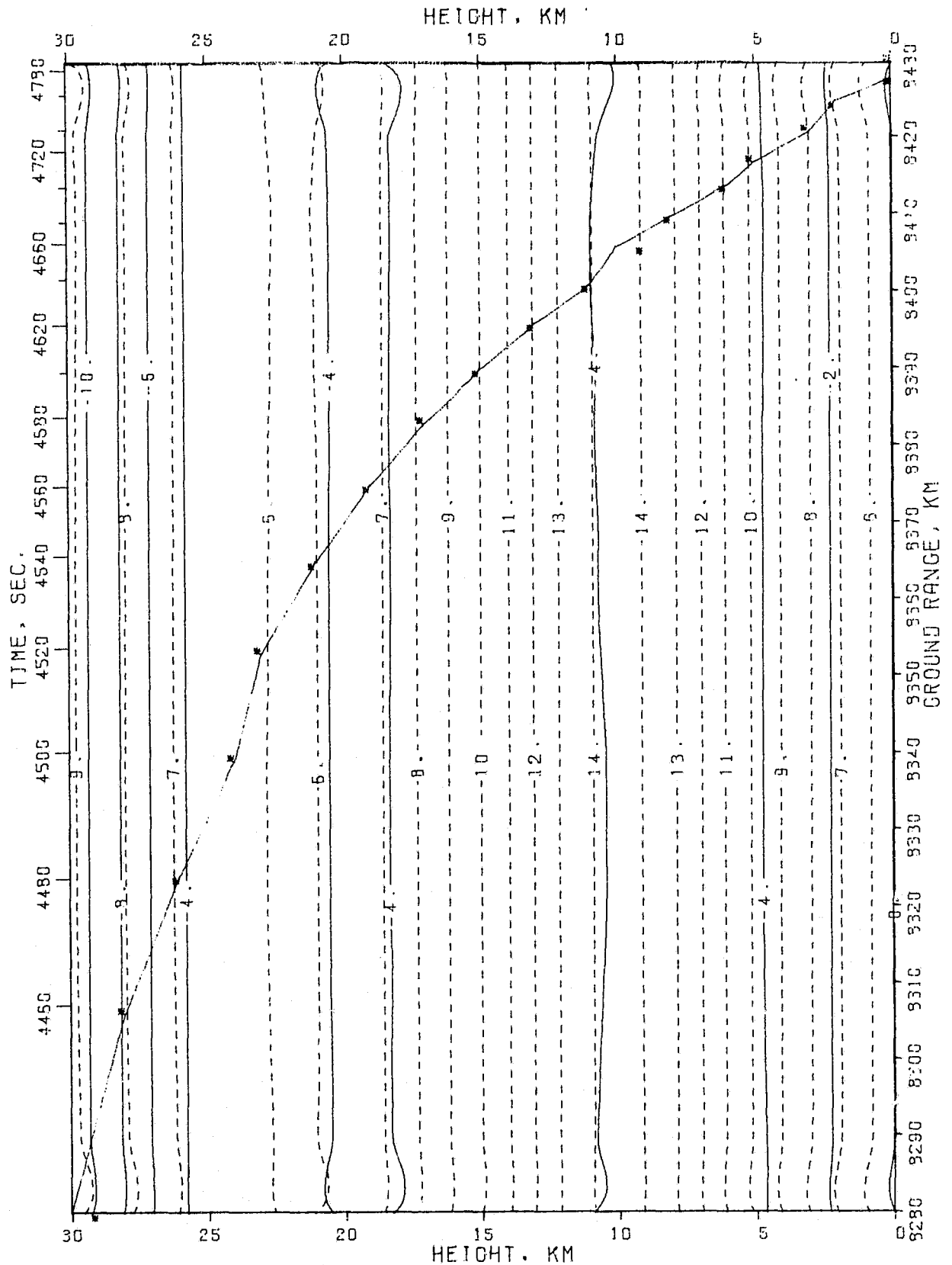


FIG 129

KEY

- NORTHWARD WIND GEOSTROPHIC MONTHLY MEAN. M/S.
- - - STD. DEV. OF NORTHWARD WIND
- * — TRAJECTORY
- DURING MONTH OF JANUARY



KEY

- UPPER 99TH PERCENTILE OF NORTHWARD WIND
 - - - LOWER 99TH PERCENTILE OF NORTHWARD WIND
 * — TRAJECTORY
 DURING MONTH OF JANUARY

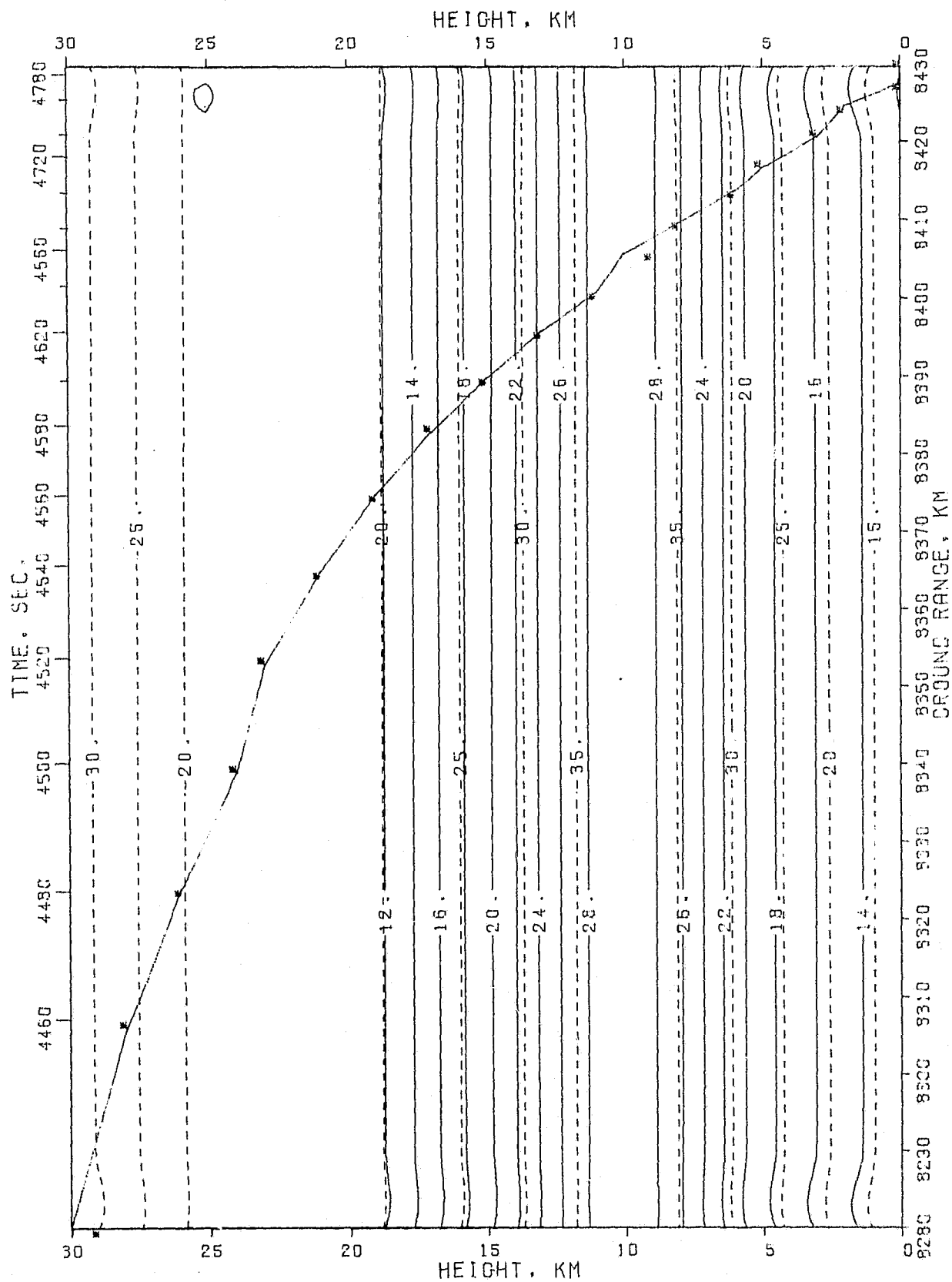
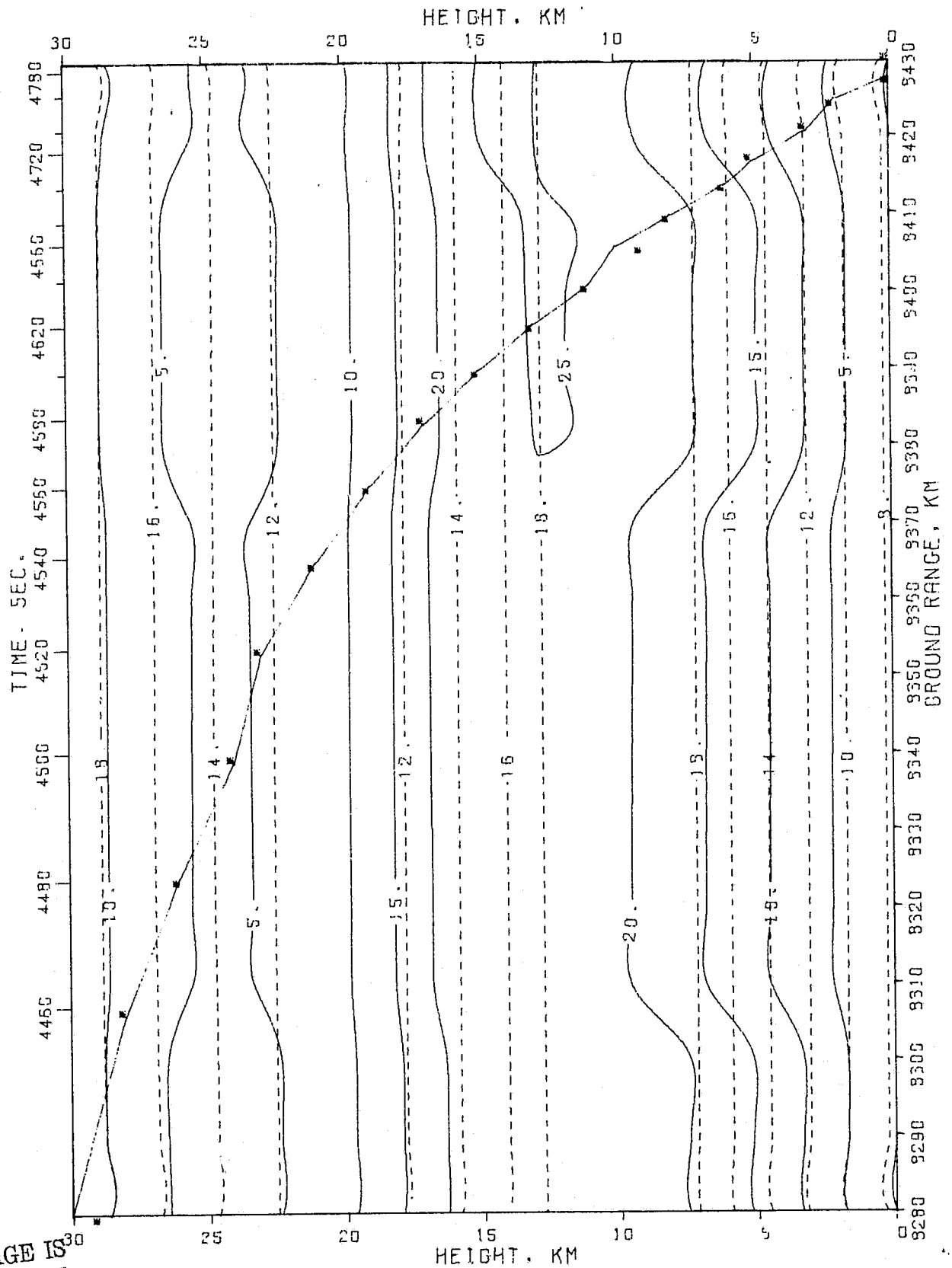


FIG 131

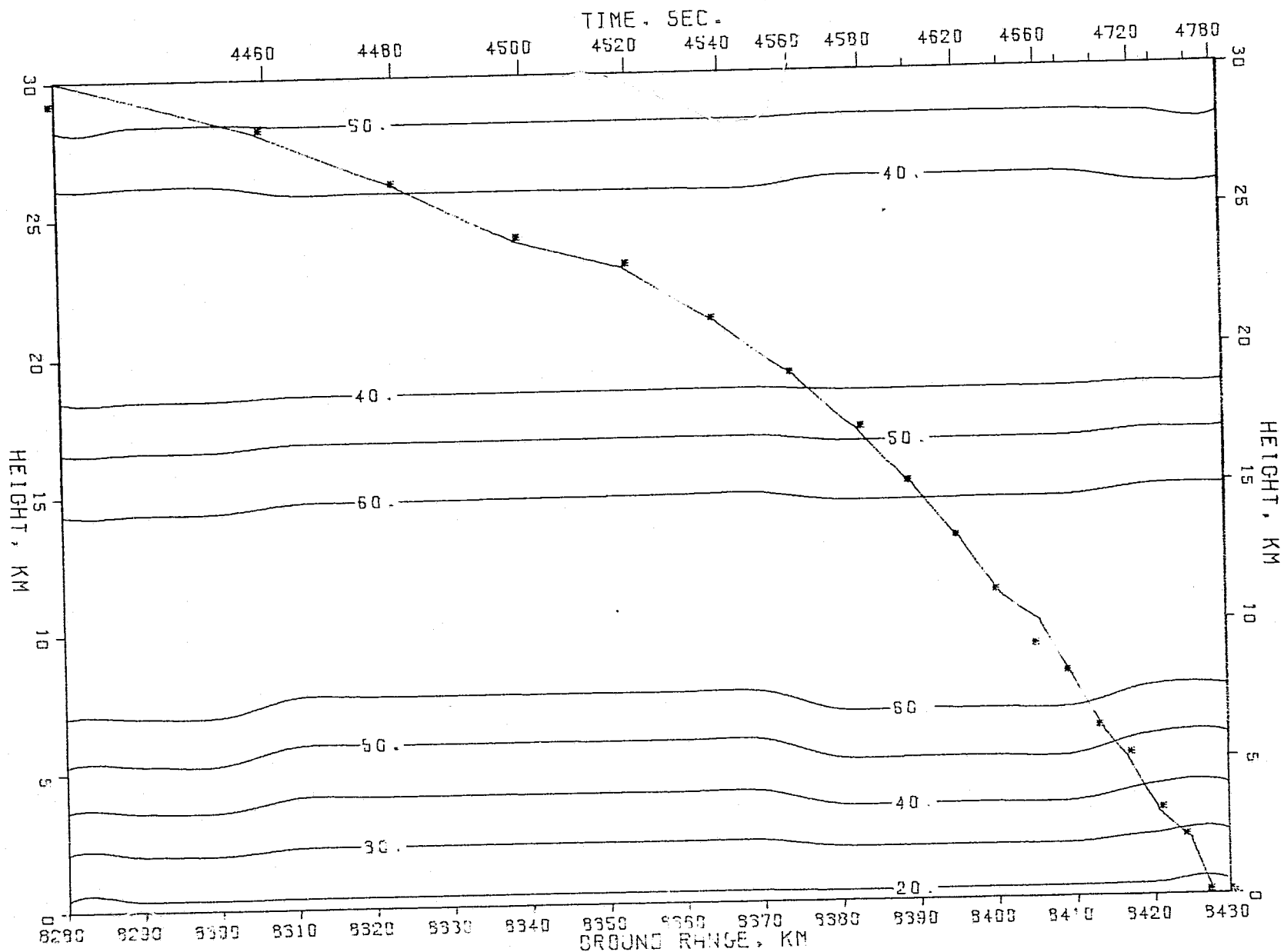
KEY
 — WIND SPEED, M/S.
 - - - STD. DEV. OF WIND SPEED
 * — TRAJECTORY
 DURING MONTH OF JANUARY

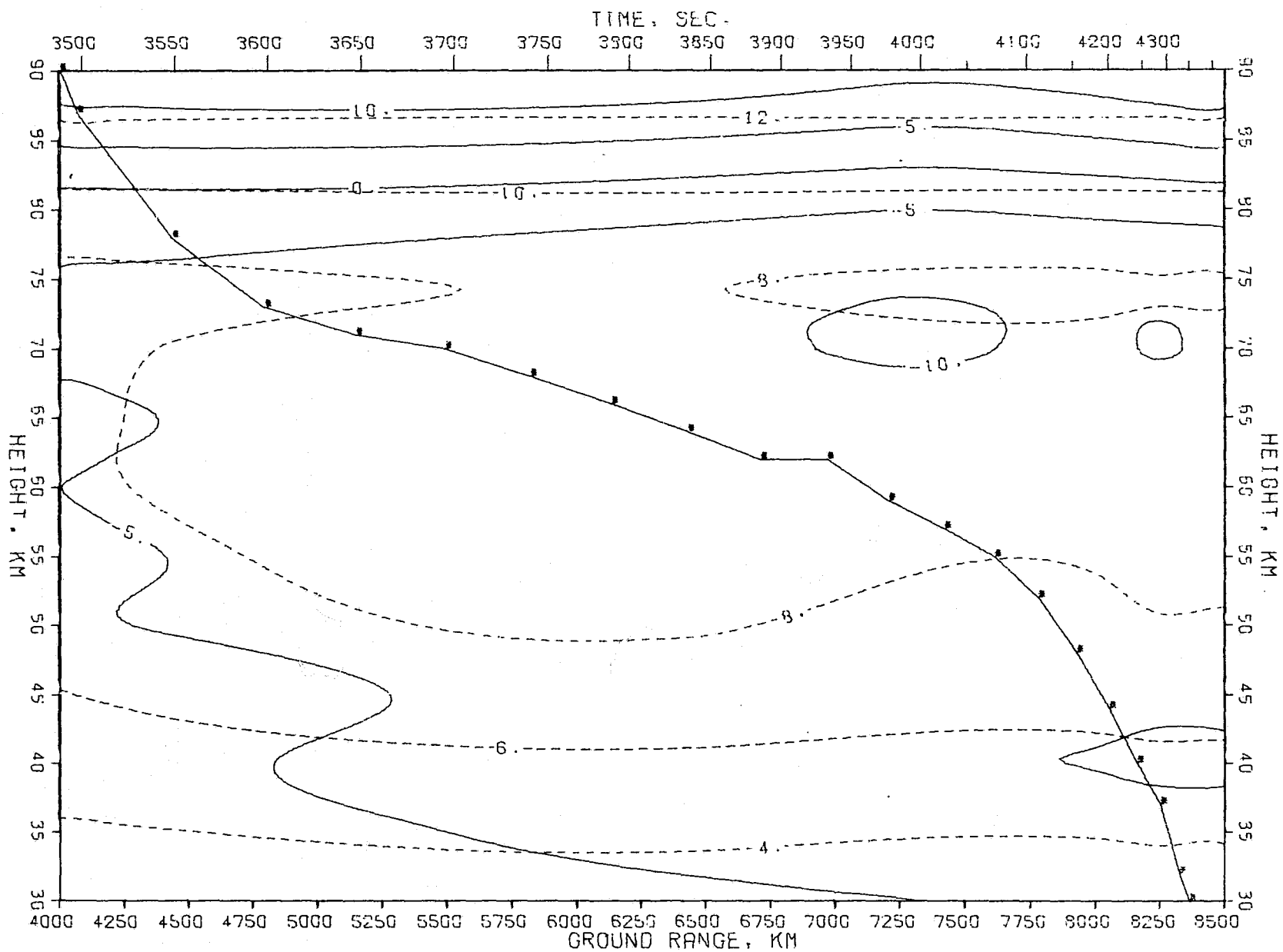


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FIG 132

KEY
 — UPPER 99TH PERCENTILE OF WIND SPEED
 - - - LOWER 99TH PERCENTILE OF WIND SPEED
 * TRAJECTORY
 DURING MONTH OF JANUARY





KEY

— PRESSURE, PERCENT DEV. FROM STD. ATM.

- - - STD. DEV. OF PRESSURE

— TRAJECTORY

DURING MONTH OF JANUARY

FIG 133

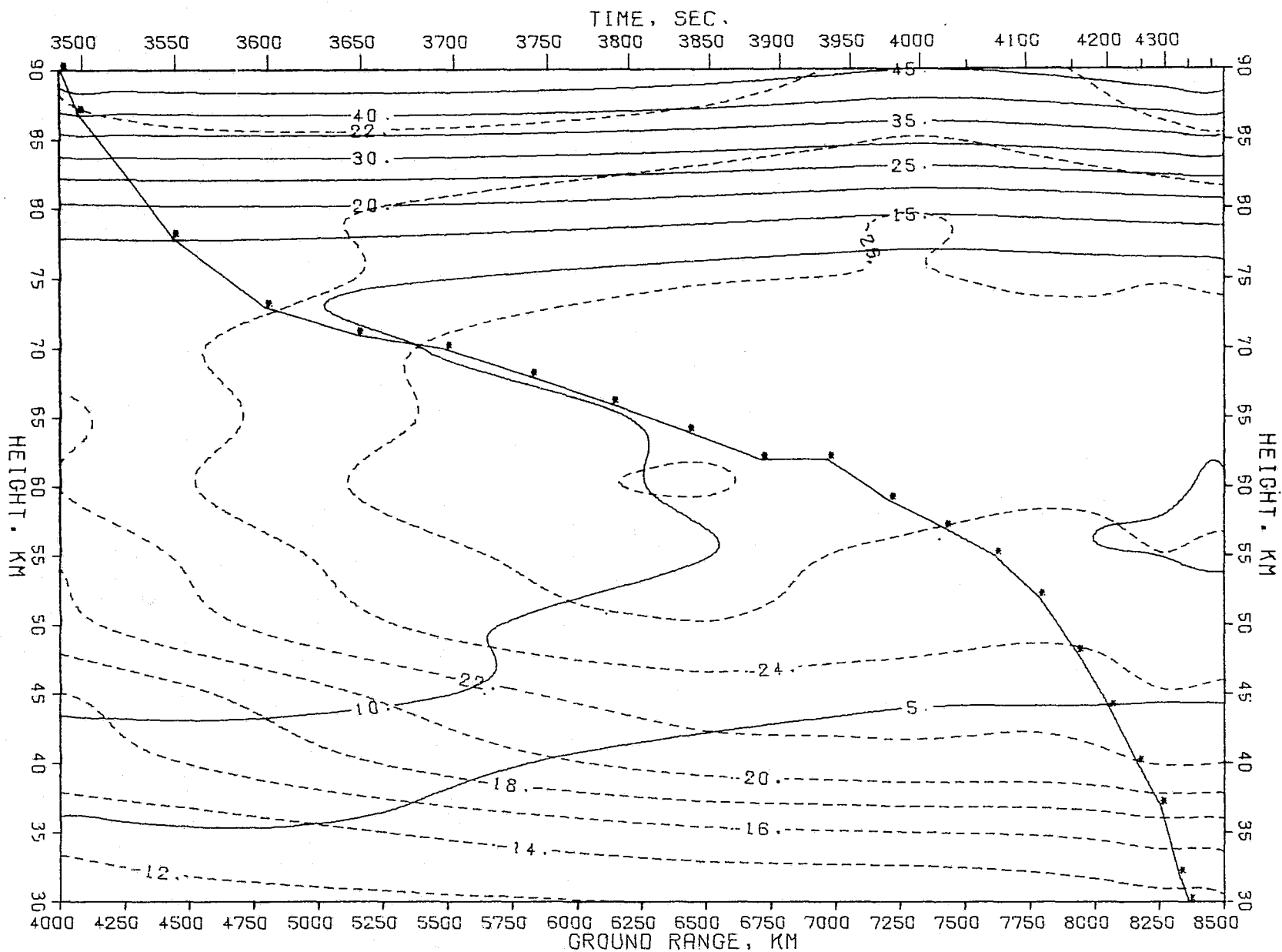


FIG 134

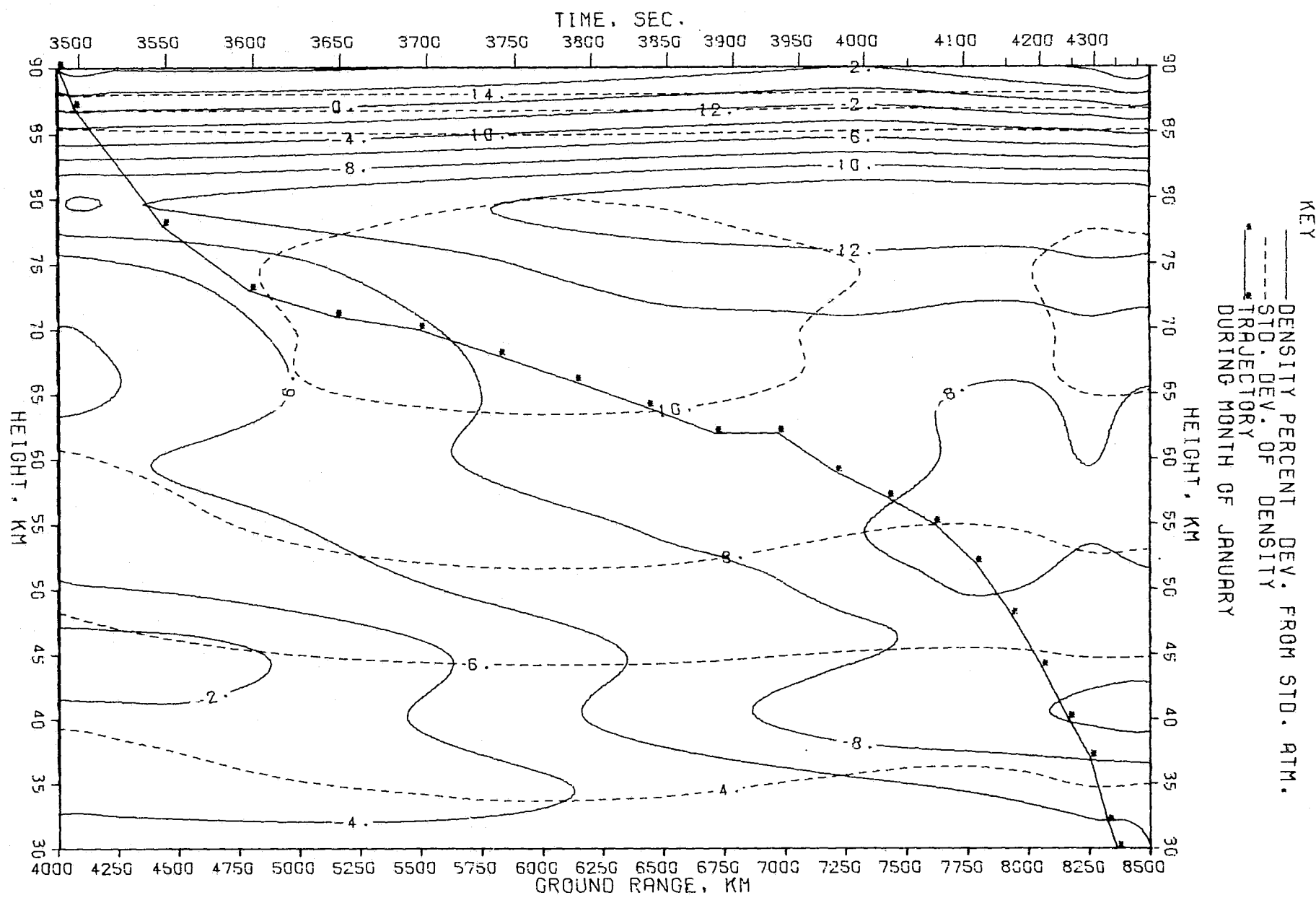


FIG 135

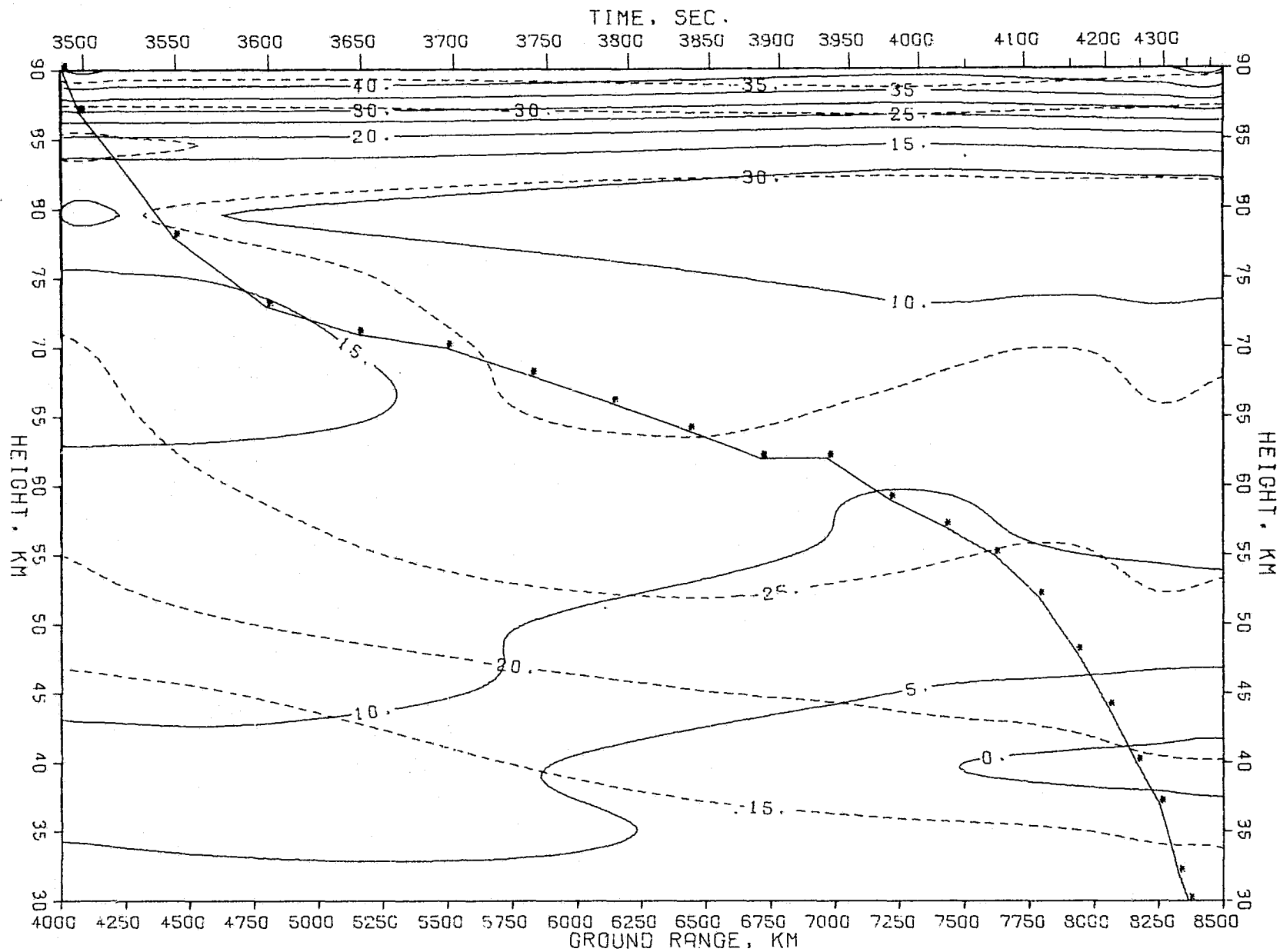
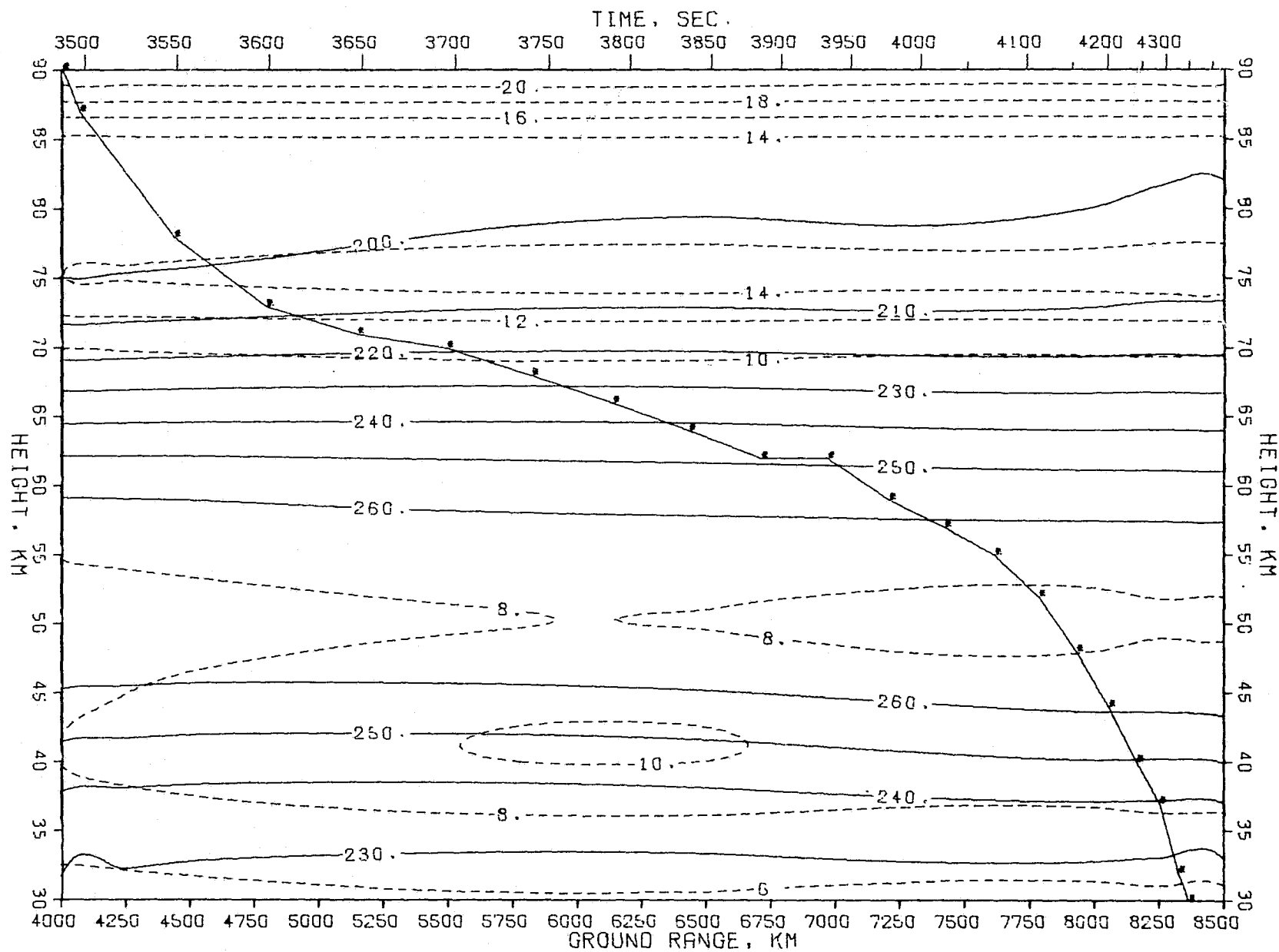


FIG 136

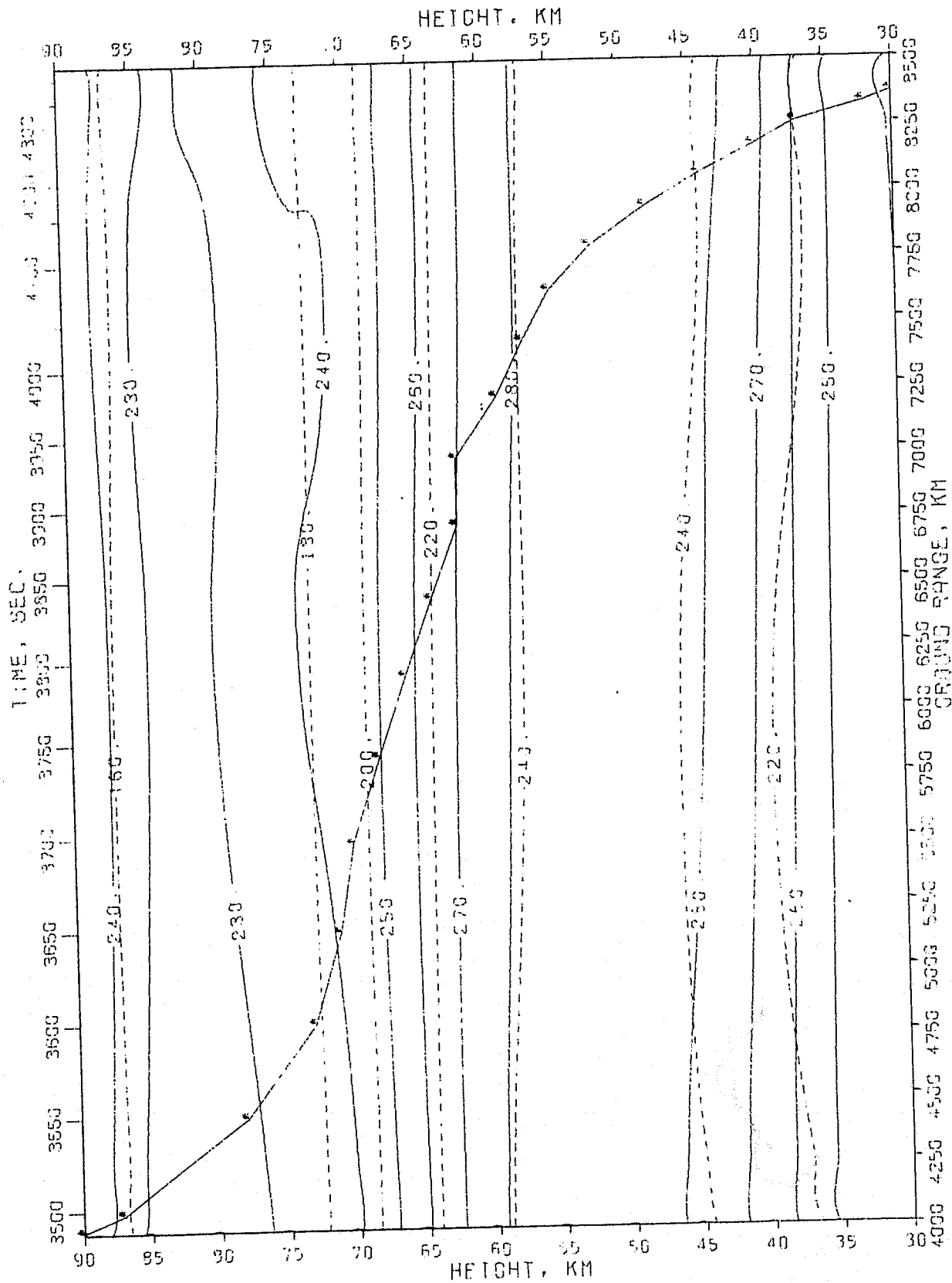
FIG 137

KEY
 — TEMPERATURE DEG. K
 - - - STD. DEV. OF TEMPERATURE
 — TRAJECTORY
 — DURING MONTH OF JANUARY

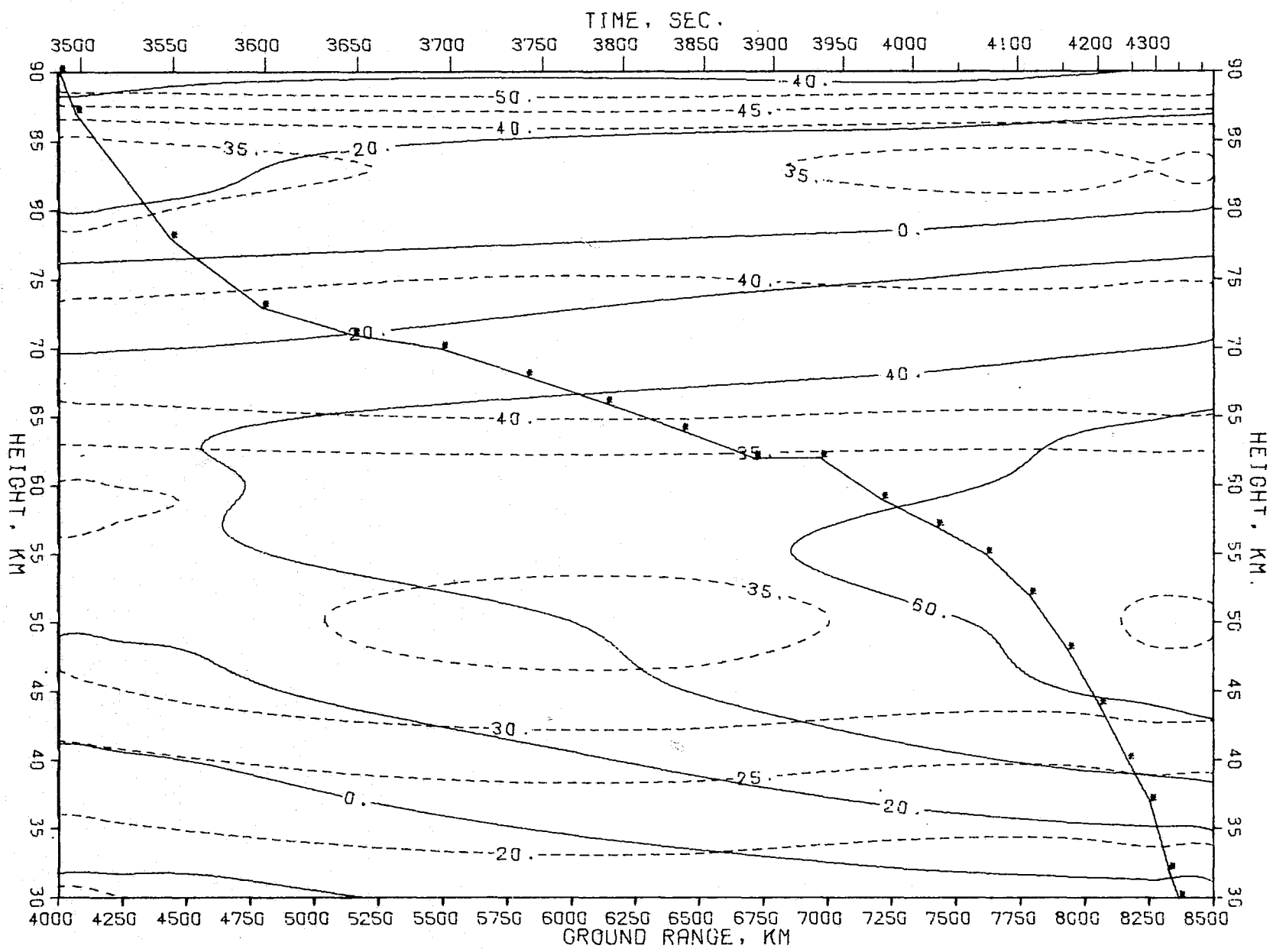


KEY

- UPPER 99TH PERCENTILE OF TEMPERATURE
- LOWER 99TH PERCENTILE OF TEMPERATURE
- TRAJECTORY
- DURING MONTH OF JANUARY



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KEY
— EASTWARD WIND GEOSTROPHIC MONTHLY MEAN, M/S.
--- STD. DEV. OF EASTWARD WIND
--- TRAJECTORY
DURING MONTH OF JANUARY

FIG 139

FIG. 140

KEY
 — UPPER 99TH PERCENTILE OF EASTWARD WIND
 - - - LOWER 99TH PERCENTILE OF EASTWARD WIND
 * TRAJECTORY
 DURING MONTH OF JANUARY

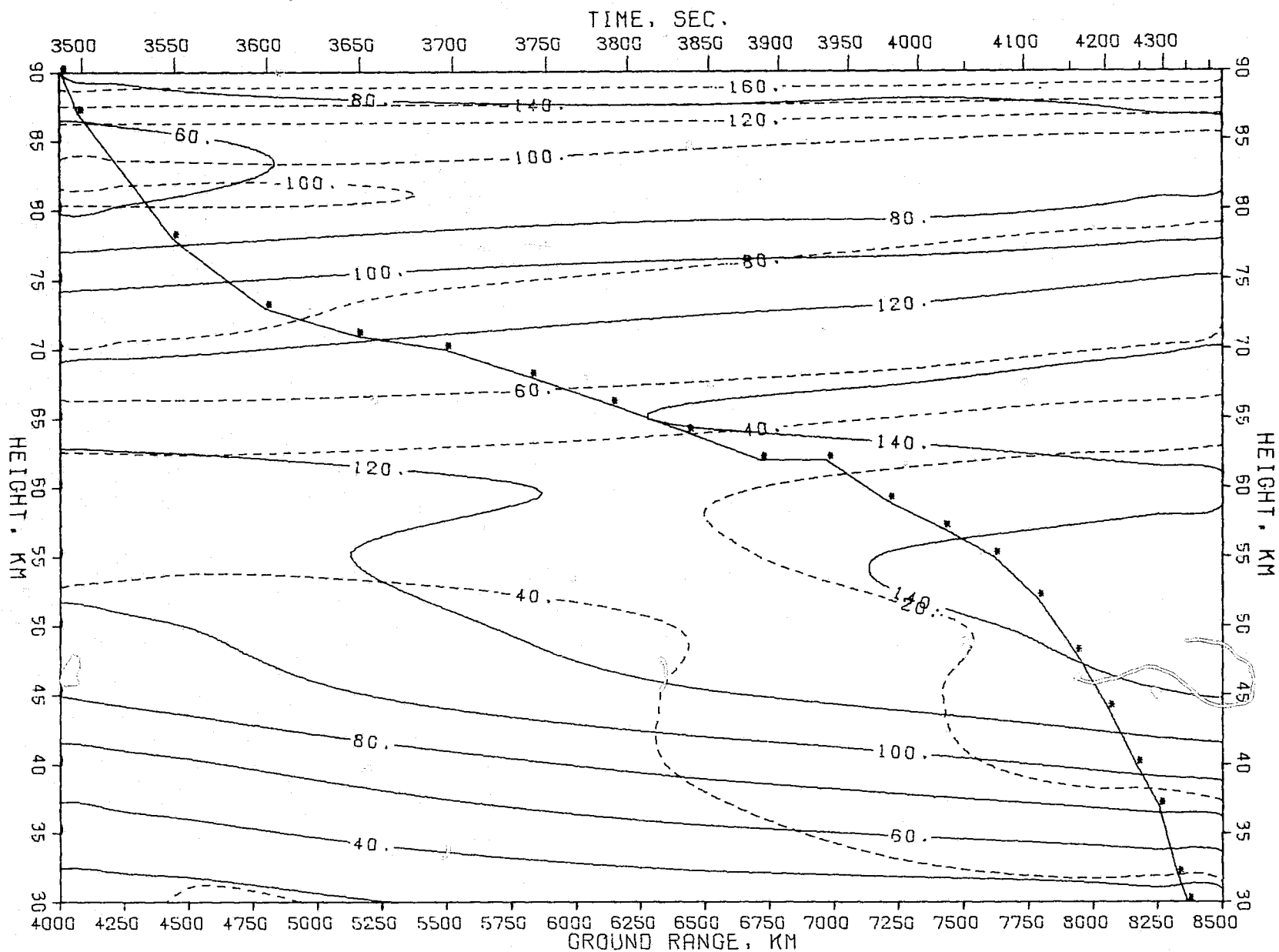


FIG 141

KEY
 — NORTHWARD WIND GEOSTROPHIC MONTHLY MEAN, M/S.
 - - - STD. DEV. OF NORTHWARD WIND
 * TRAJECTORY
 DURING MONTH OF JANUARY

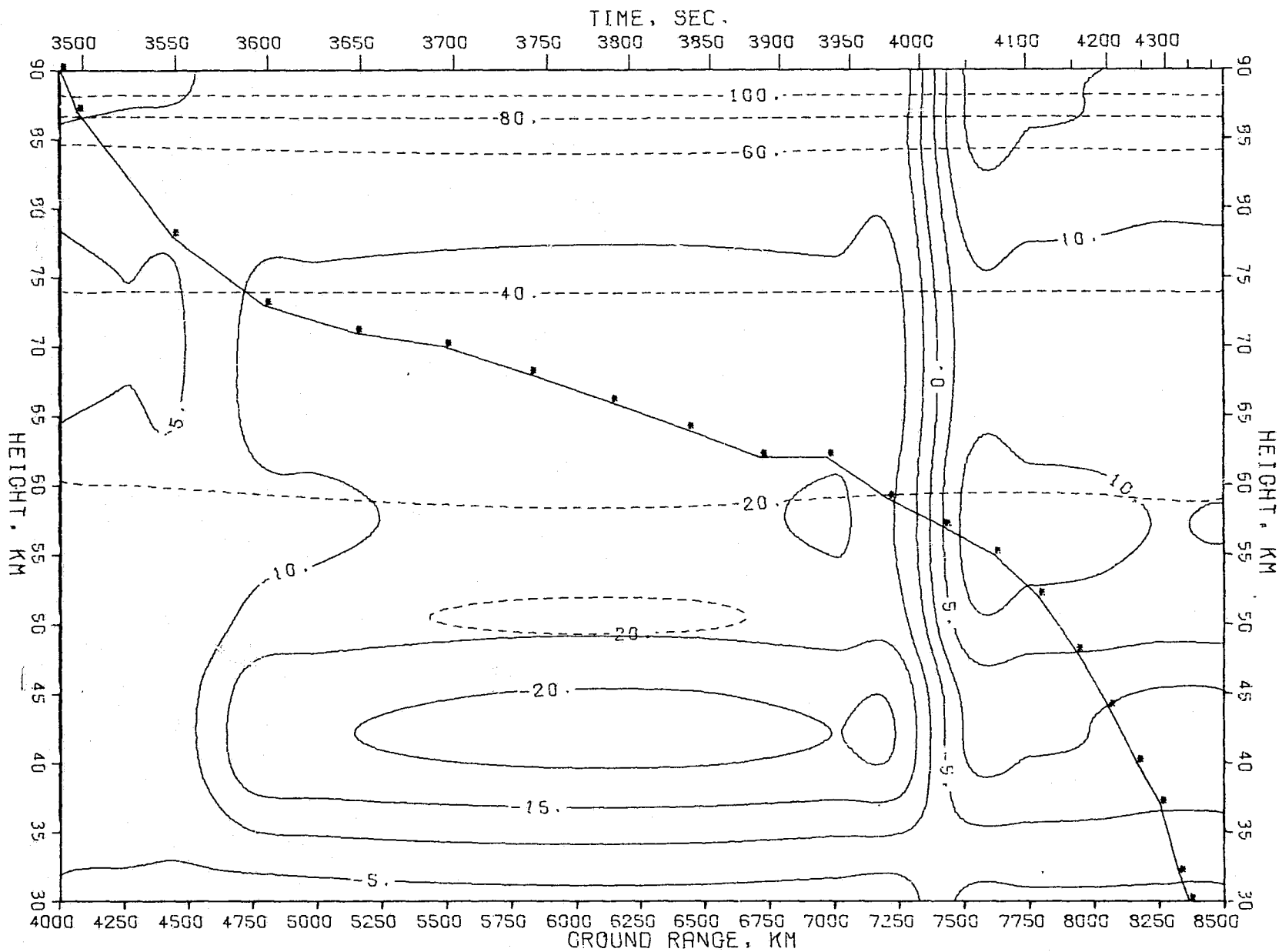


FIG 142

KEY

— UPPER 99TH PERCENTILE OF NORTHWARD WIND
 --- LOWER 99TH PERCENTILE OF NORTHWARD WIND
 * TRAJECTORY
 DURING MONTH OF JANUARY

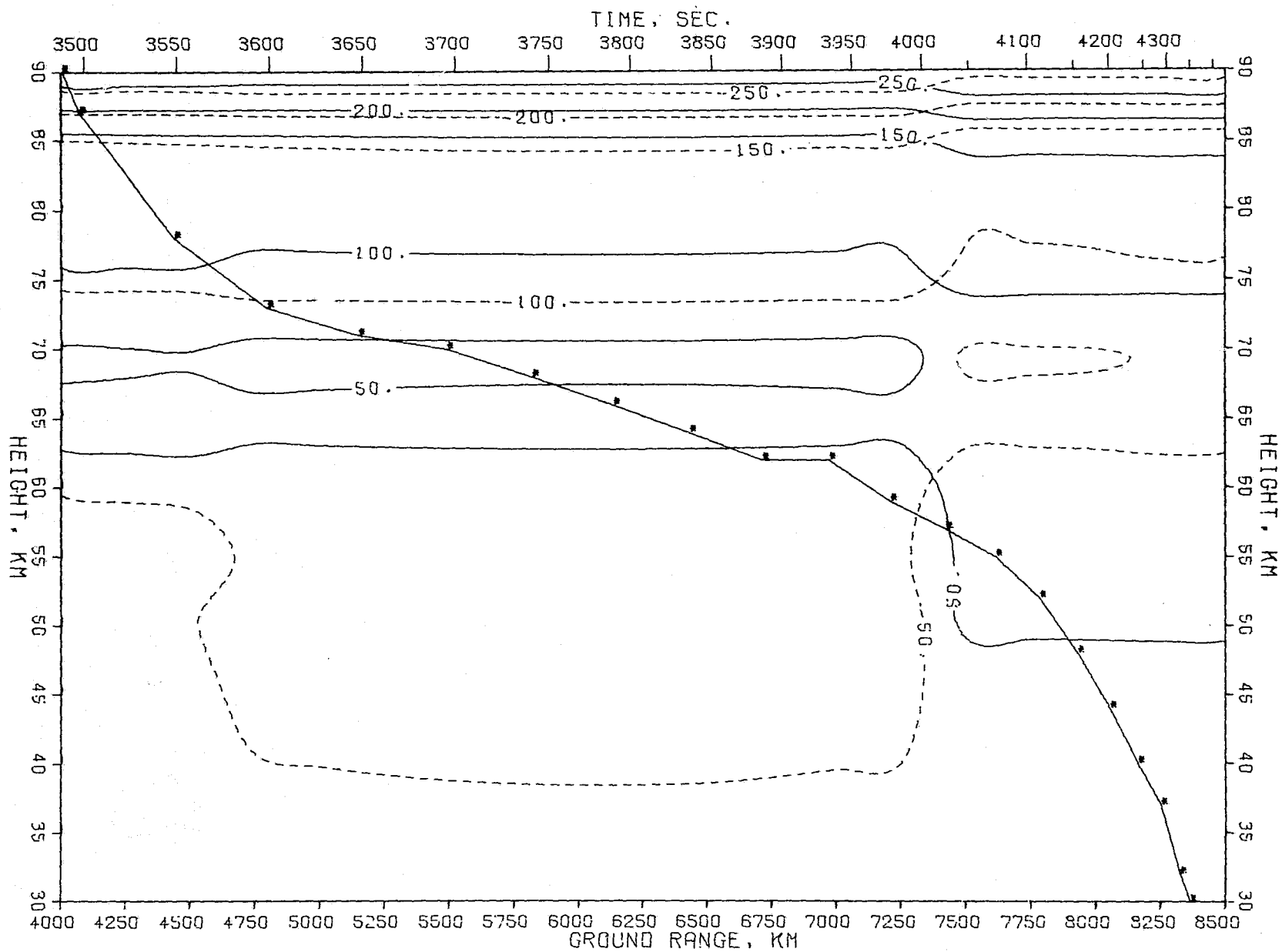
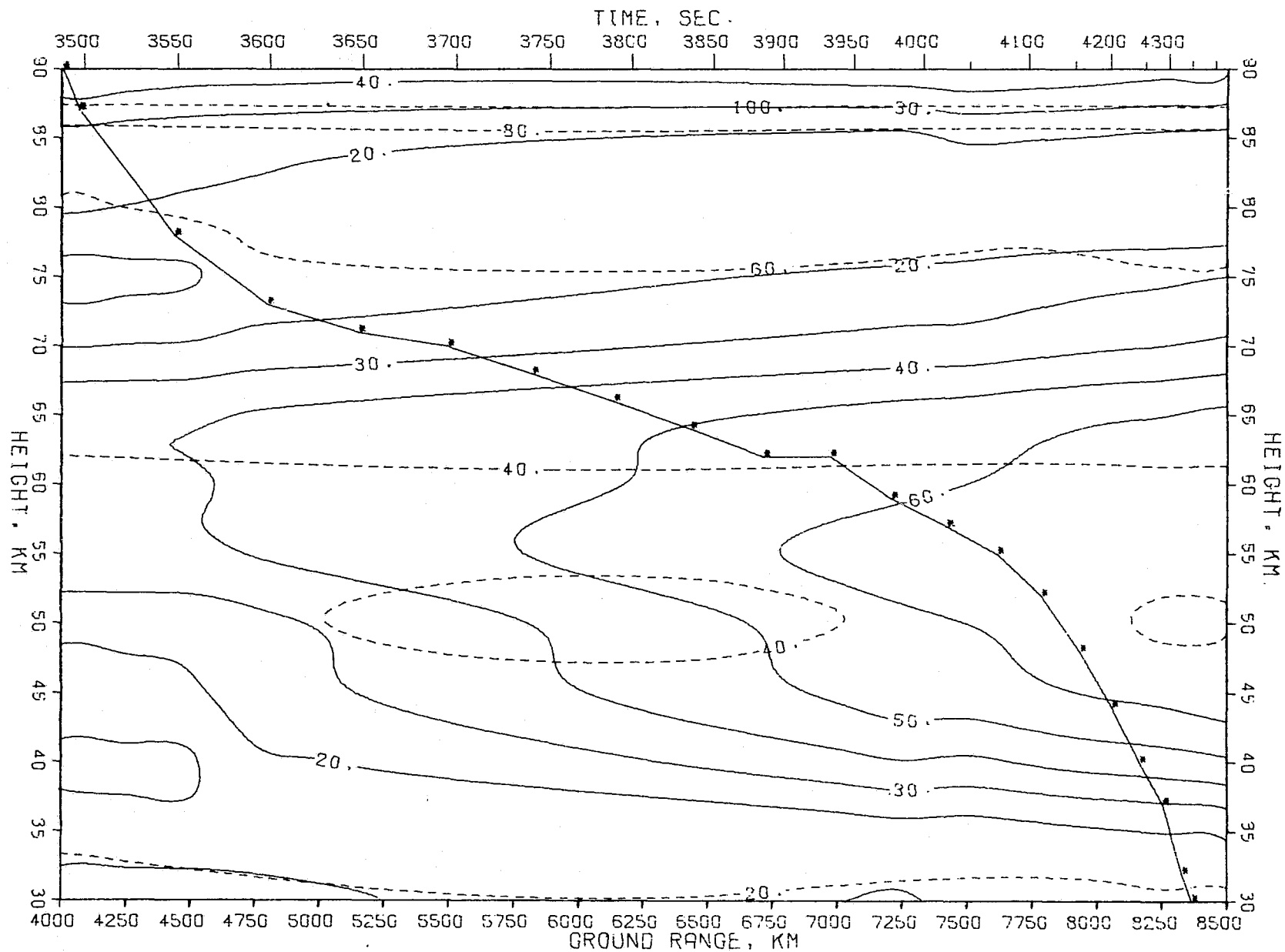


FIG 143

KEY
 — WIND SPEED, M/S.
 - - - STD. DEV. OF WIND SPEED
 — TRAJECTORY
 — DURING MONTH OF JANUARY



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FIG 144

KEY
 — UPPER 99TH PERCENTILE OF WIND SPEED
 - - - LOWER 99TH PERCENTILE OF WIND SPEED
 * TRAJECTORY
 DURING MONTH OF JANUARY

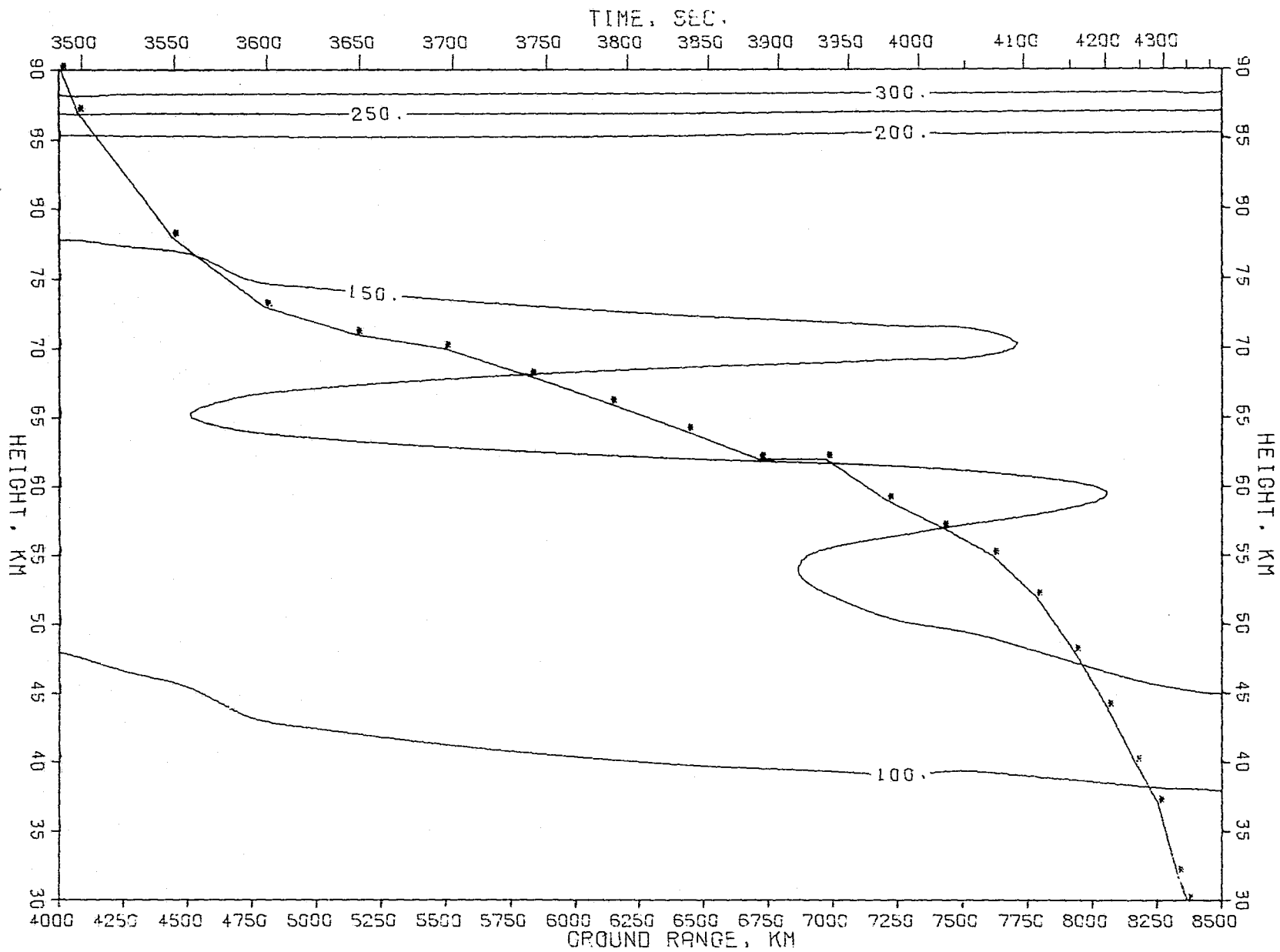


FIG 145

KEY

— PRESSURE. PERCENT DEV. FROM STD. ATM.

- - - STD. DEV. OF PRESSURE

* — TRAJECTORY

DURING MONTH OF JANUARY WITH HIGH SOLAR ACTIVITY

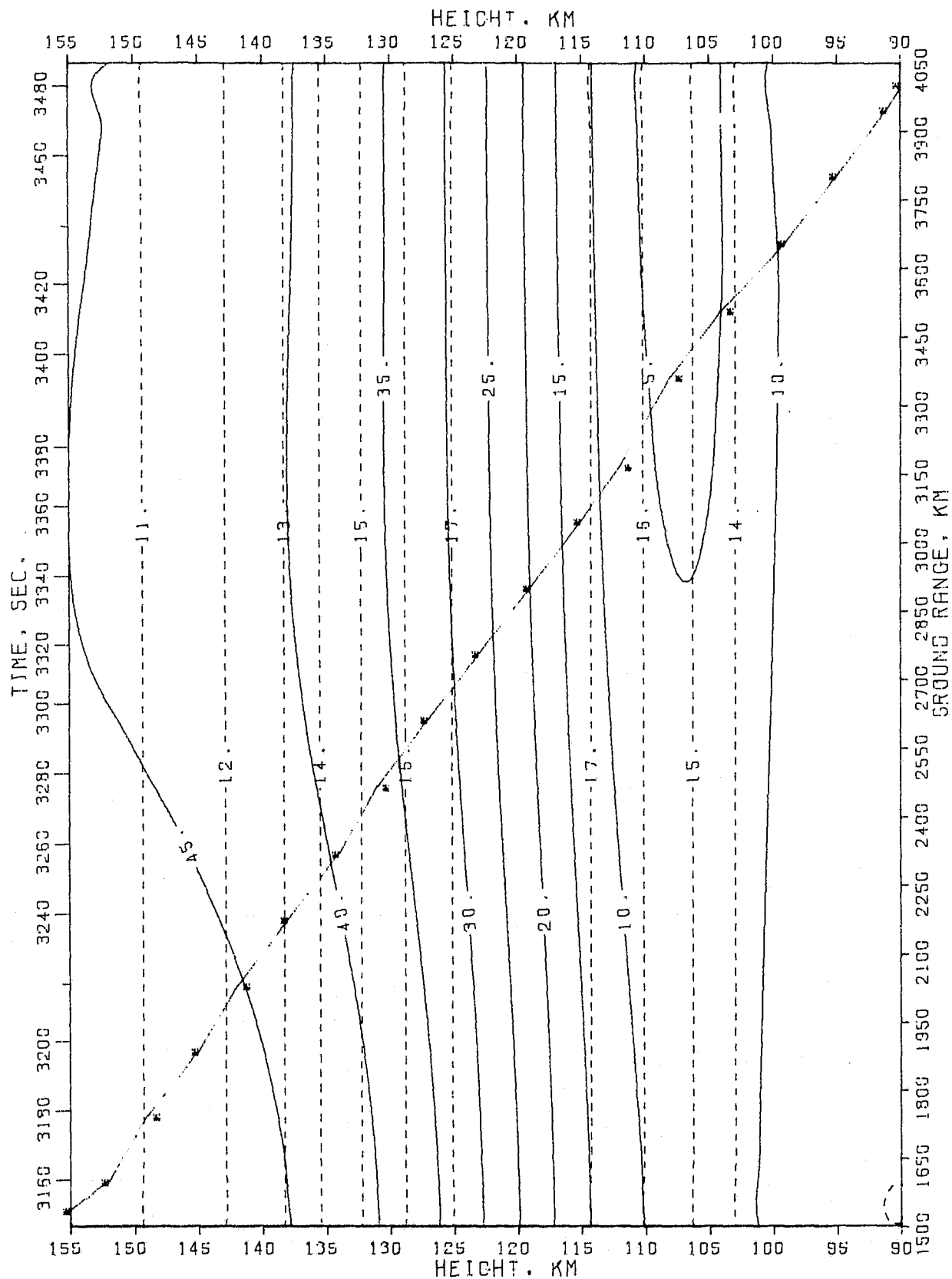
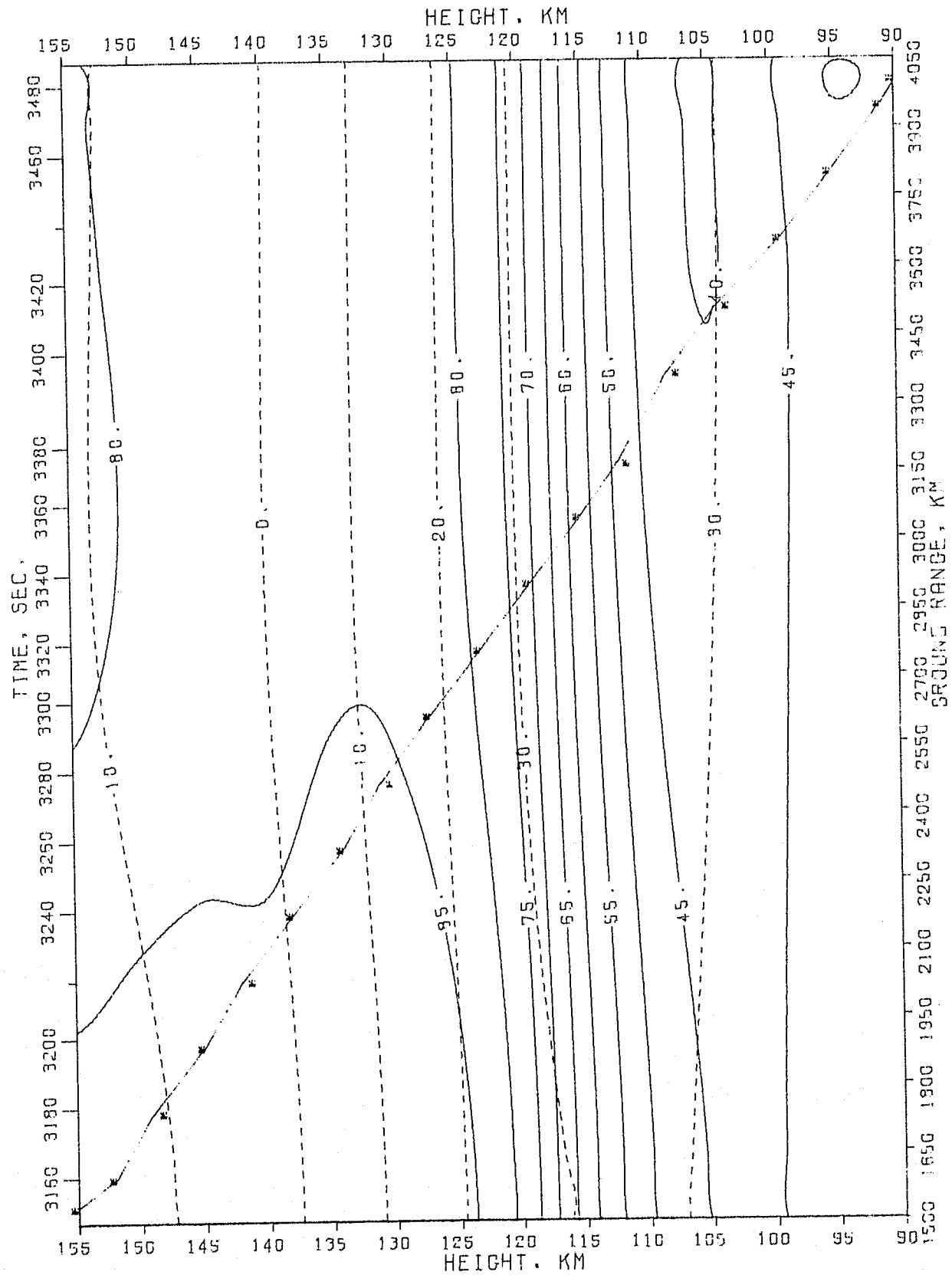


FIG 146

KEY

----- UPPER 99TH PERCENTILE OF PRESSURE
 ----- LOWER 99TH PERCENTILE OF PRESSURE
 * - - - - TRAJECTORY

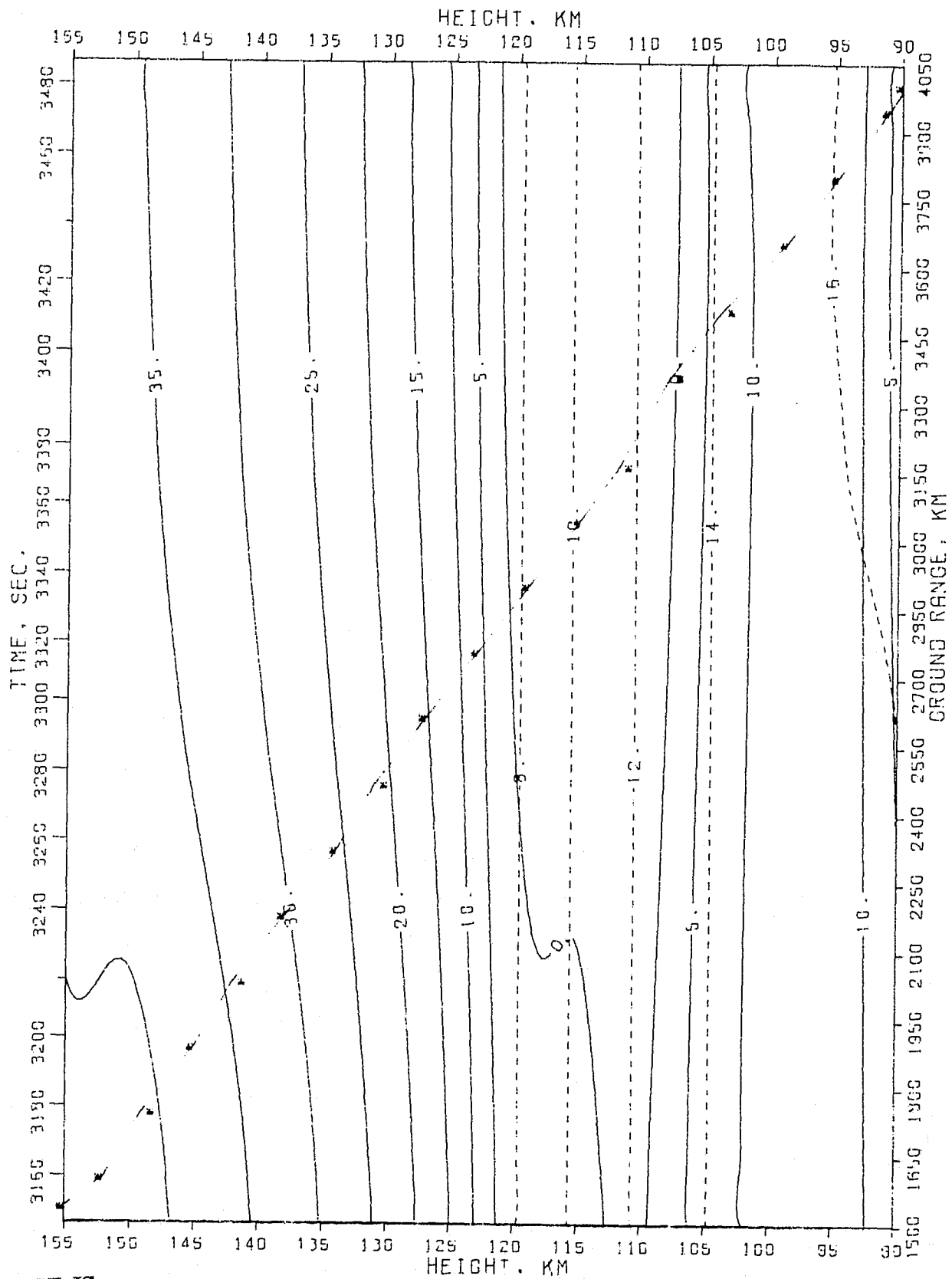
DURING MONTH OF JANUARY WITH HIGH SOLAR ACTIVITY



-----STD. DEV. OF DENSITY

TRAJECTORY

DURING MONTH OF JANUARY WITH HIGH SOLAR ACTIVITY



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KEY Y

- LOWER 99TH PERCENTILE OF DENSITY

TRAJECTORY

DURING MONTH OF JANUARY WITH HIGH SOLAR ACTIVITY

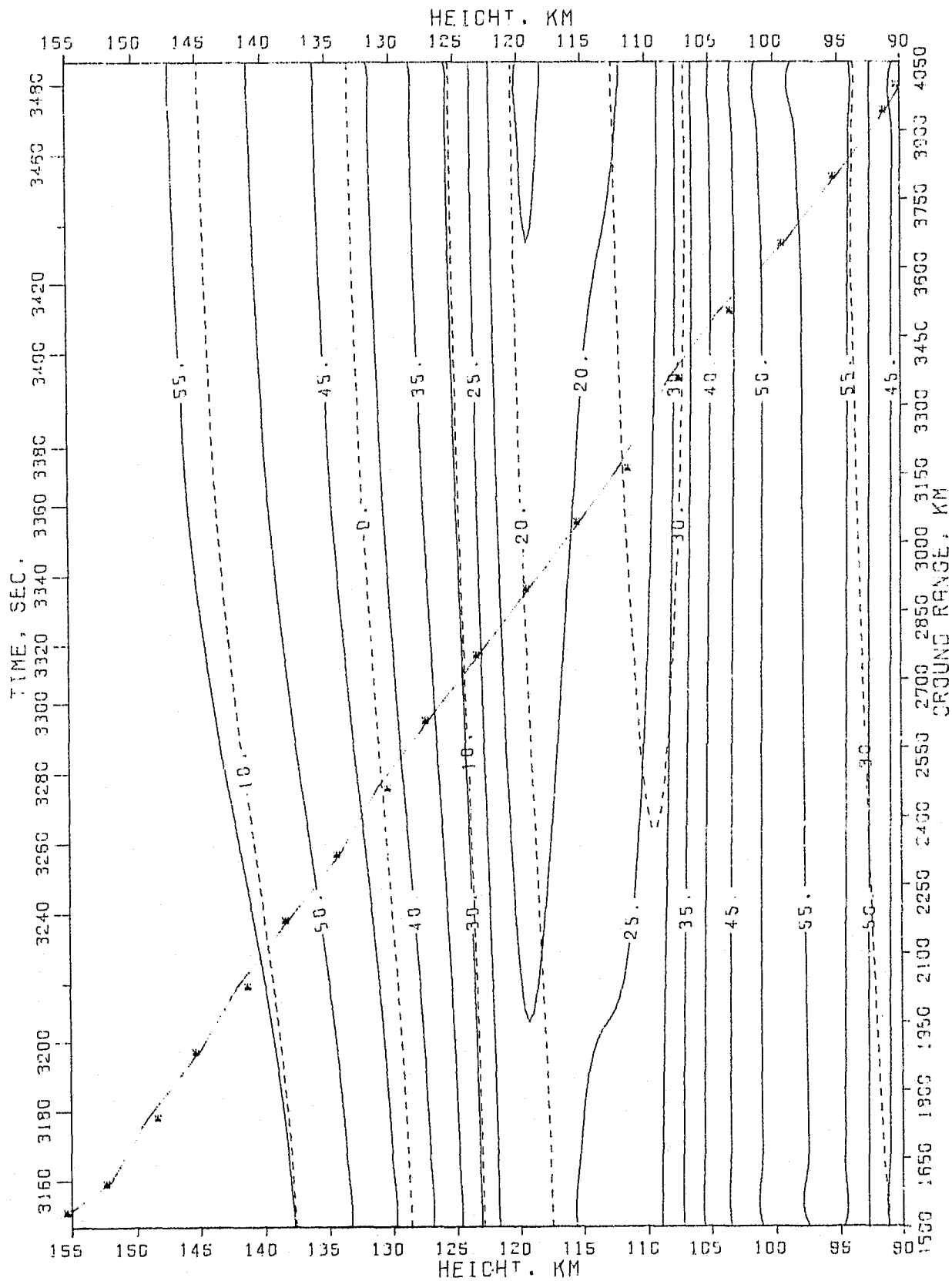
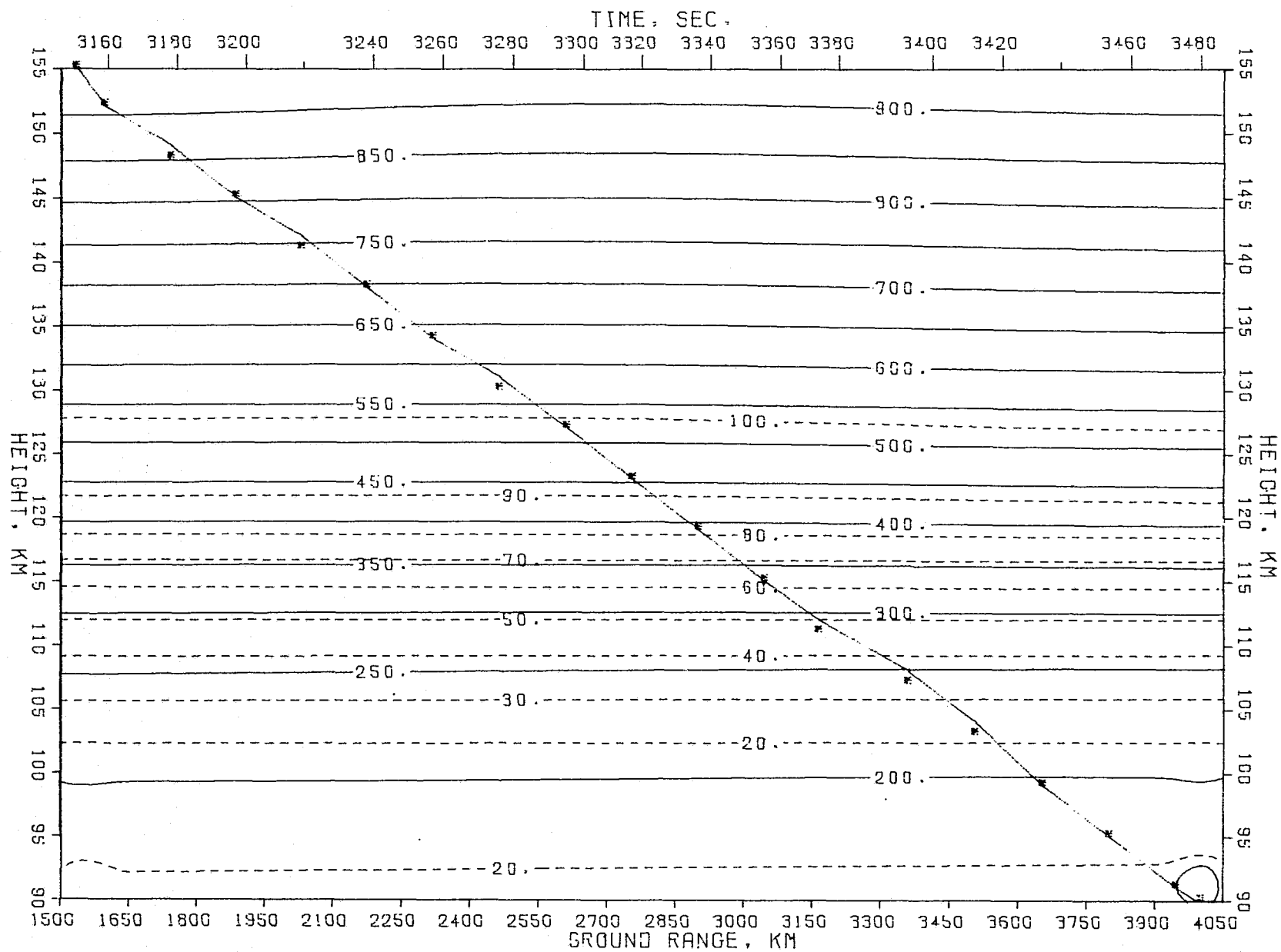


FIG 149

KEY
 ——— TEMPERATURE DEG. K
 - - - - - STD. DEV. OF TEMPERATURE
 * * * * * TRAJECTORY
 DURING MONTH OF JANUARY WITH HIGH SOLAR ACTIVITY



KEY

- UPPER 99TH PERCENTILE OF TEMPERATURE
- - - LOWER 99TH PERCENTILE OF TEMPERATURE
- * TRAJECTORY

DURING MONTH OF JANUARY WITH HIGH SOLAR ACTIVITY

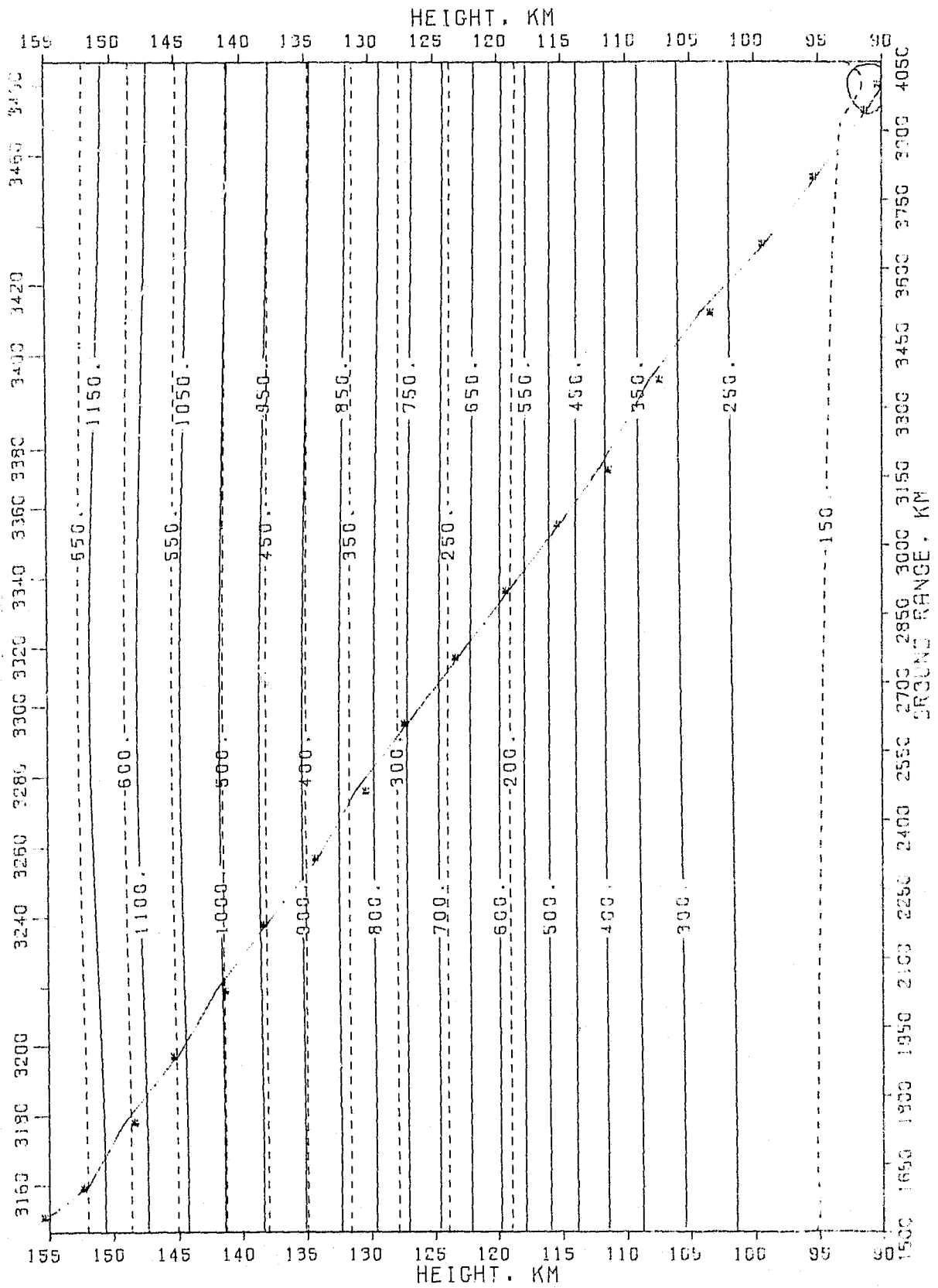
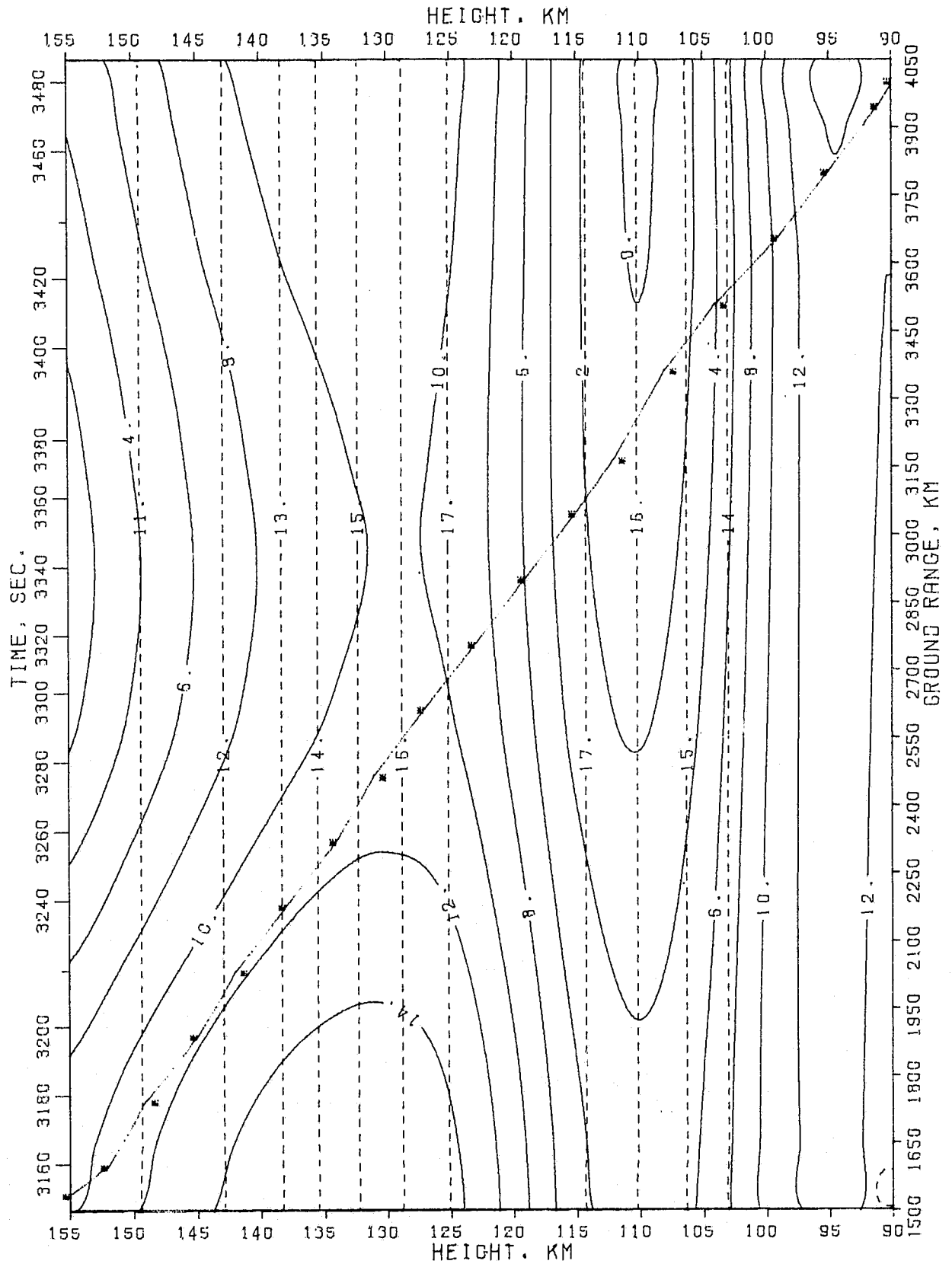


FIG 151

KEY

- PRESSURE. PERCENT DEV. FROM STD. ATM.
- - - STD. DEV. OF PRESSURE
- ● — TRAJECTORY

DURING MONTH OF JANUARY WITH AVERAGE SOLAR ACTIVITY



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FIG 152

KEY

—— UPPER 99TH PERCENTILE OF PRESSURE
 ---- LOWER 99TH PERCENTILE OF PRESSURE
 * — * TRAJECTORY

DURING MONTH OF JANUARY WITH AVERAGE SOLAR ACTIVITY

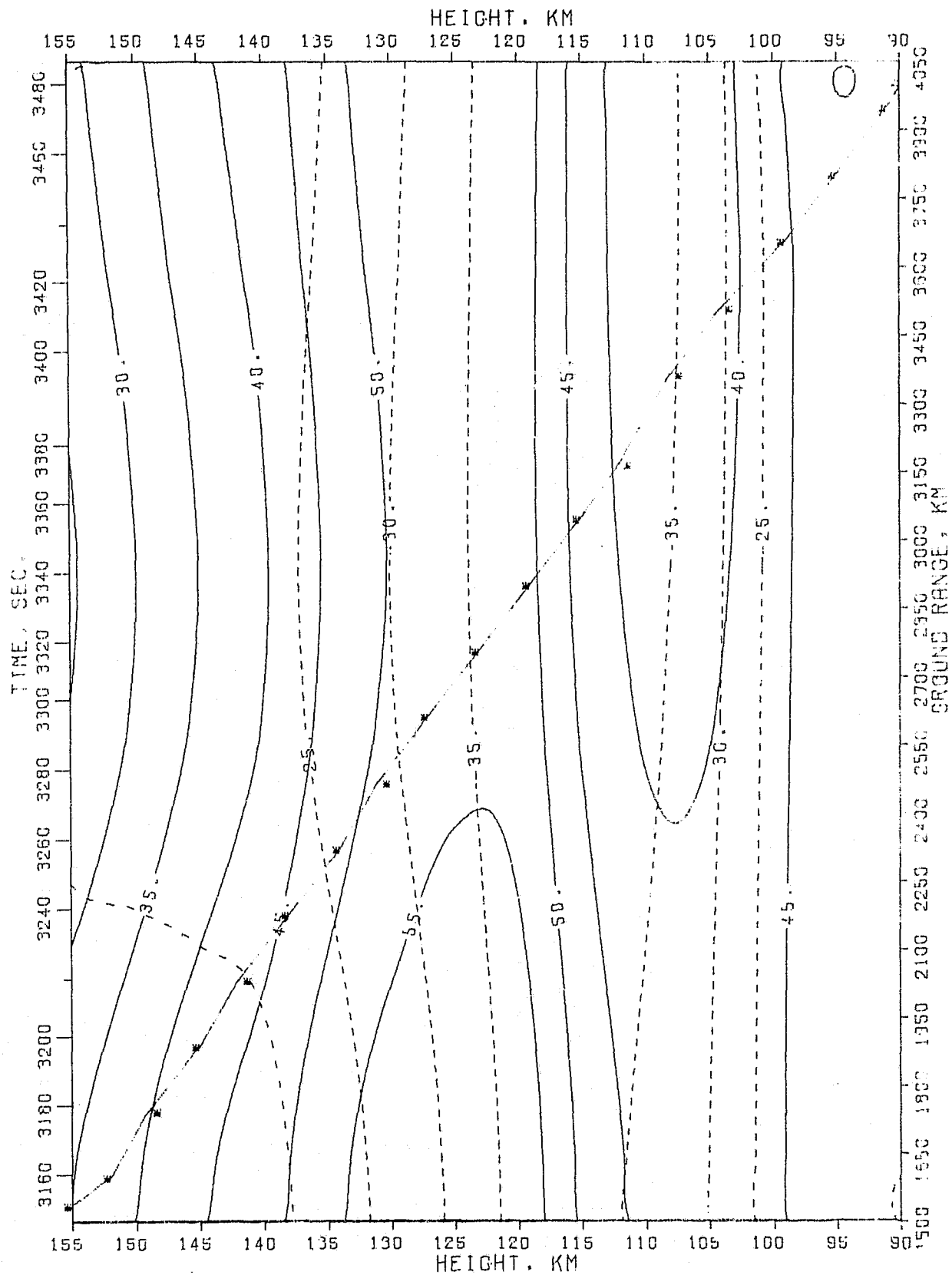


FIG 153

KEY

- DENSITY PERCENT DEV. FROM STD. ATM.
- - - STD. DEV. OF DENSITY
- * - - - TRAJECTORY

DURING MONTH OF JANUARY WITH AVERAGE SOLAR ACTIVITY

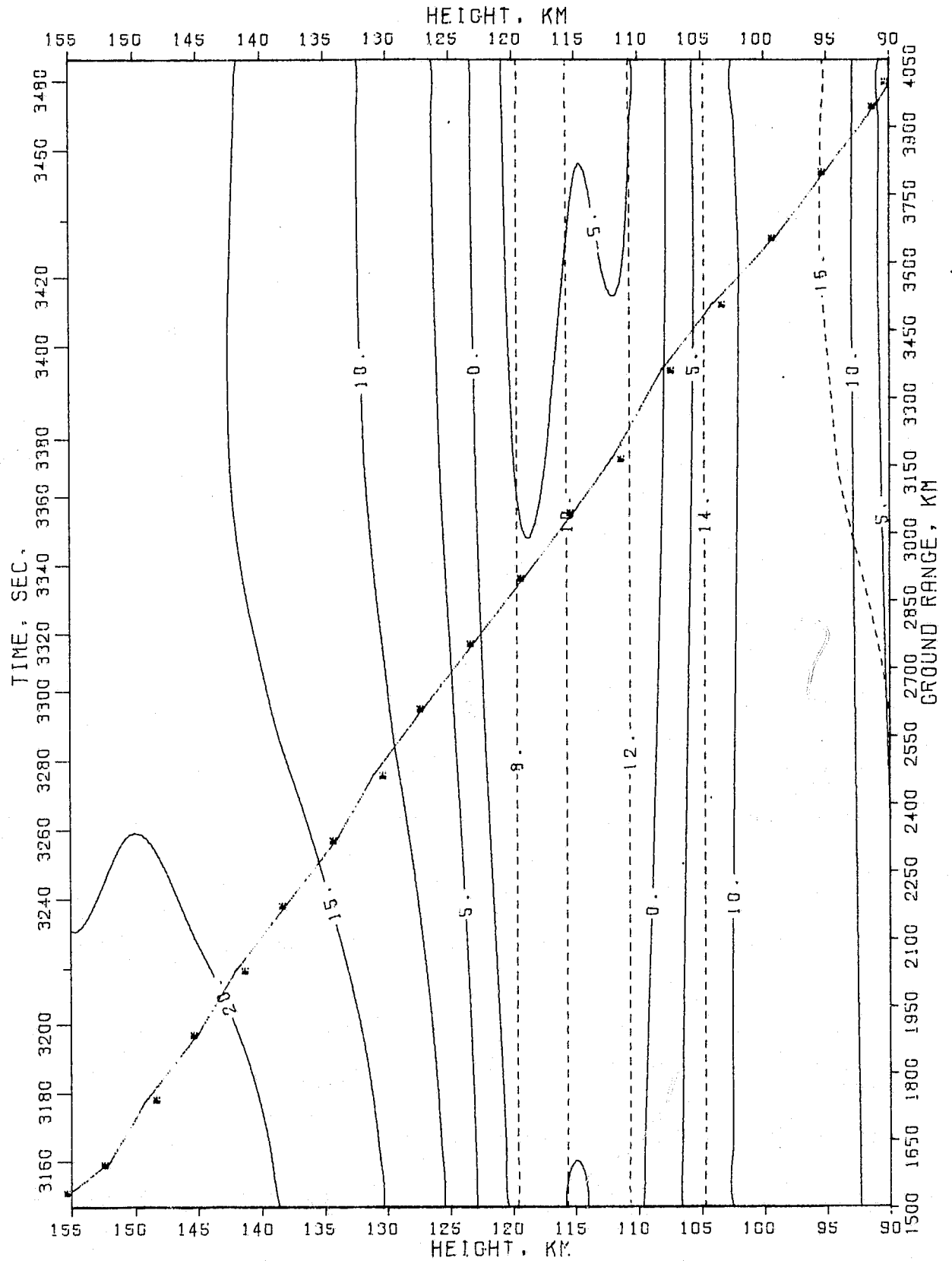
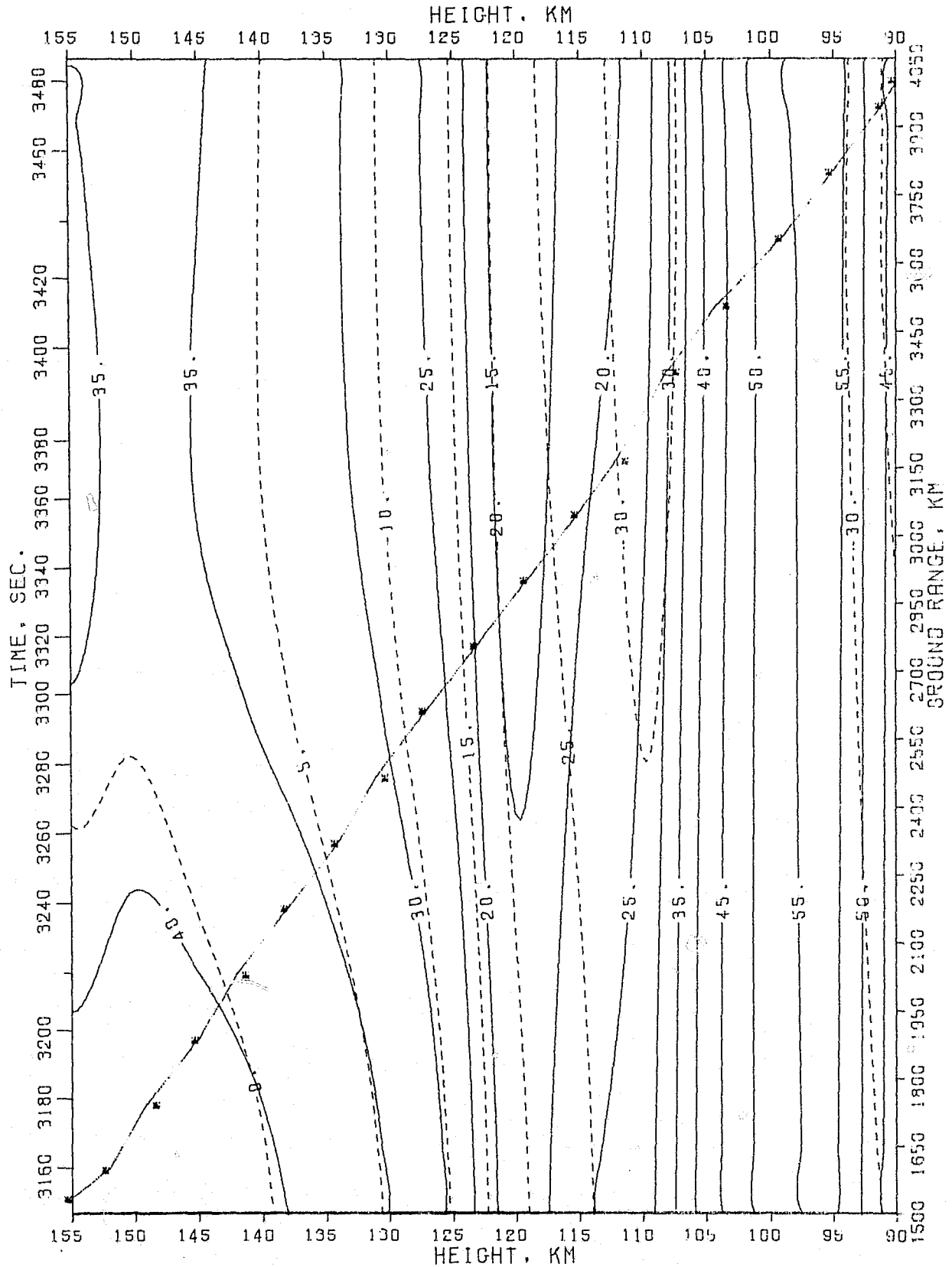


FIG 154

KEY

- UPPER 99TH PERCENTILE OF DENSITY
- - - LOWER 99TH PERCENTILE OF DENSITY
- * — TRAJECTORY

DURING MONTH OF JANUARY WITH AVERAGE SOLAR ACTIVITY



KEY

- TEMPERATURE DEG. K
 - STD. DEV. OF TEMPERATURE
 - TRAJECTORY
- DURING MONTH OF JANUARY WITH AVERAGE SOLAR ACTIVITY

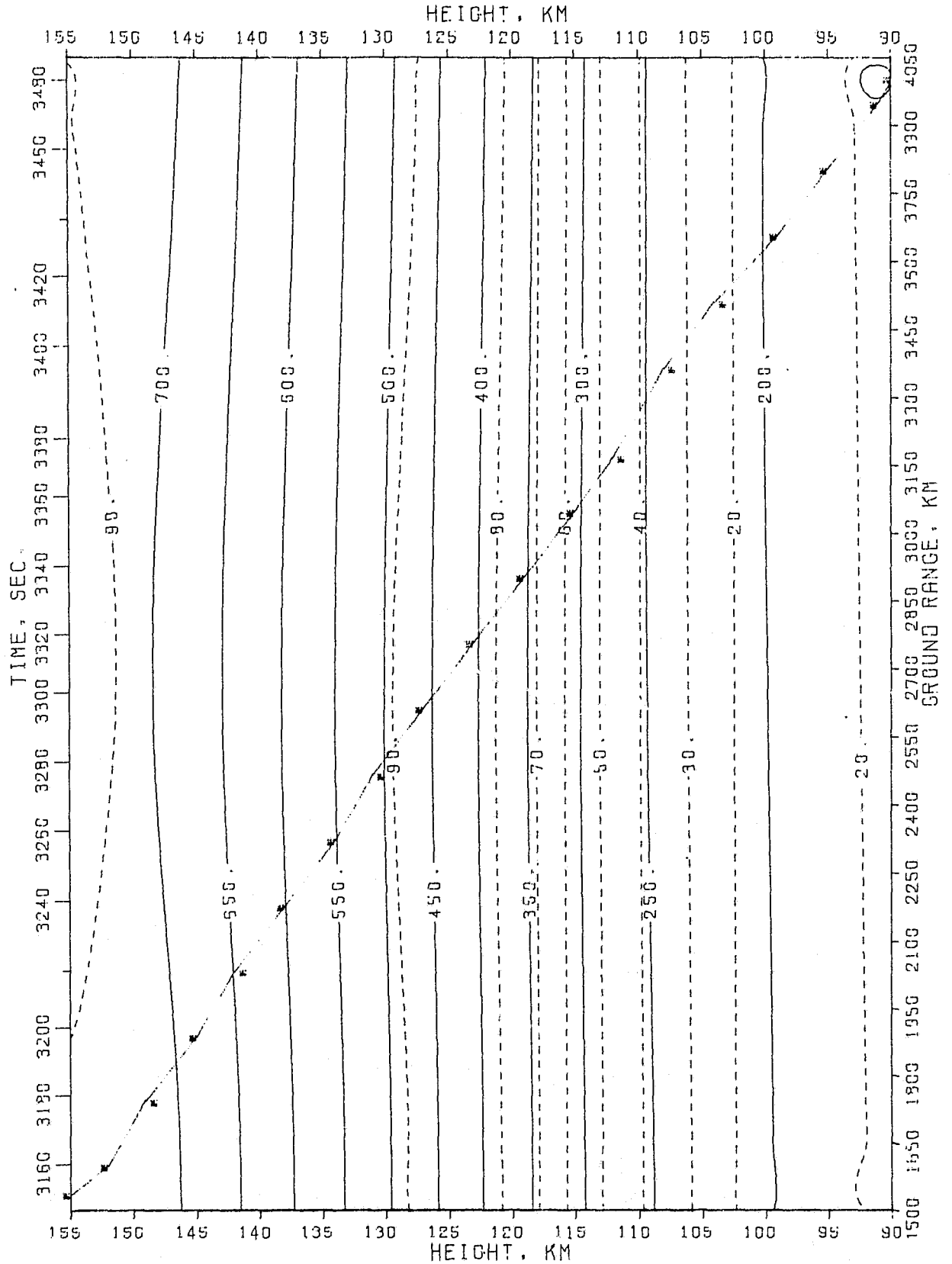


FIG 156

KEY

- UPPER 99TH PERCENTILE OF TEMPERATURE
 - - - - - LOWER 99TH PERCENTILE OF TEMPERATURE
 * - - - * TRAJECTORY

DURING MONTH OF JANUARY WITH AVERAGE SOLAR ACTIVITY

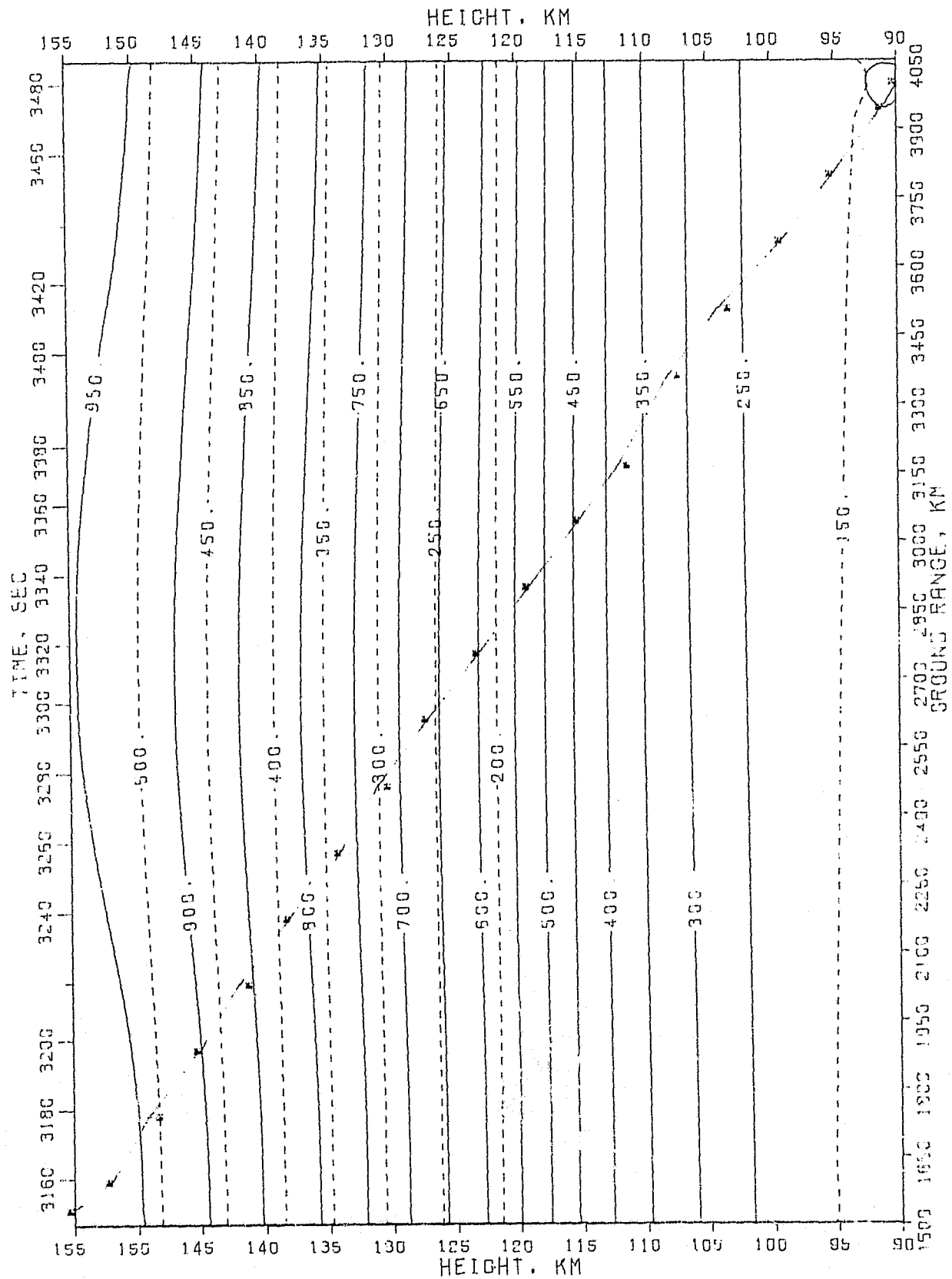


FIG 157

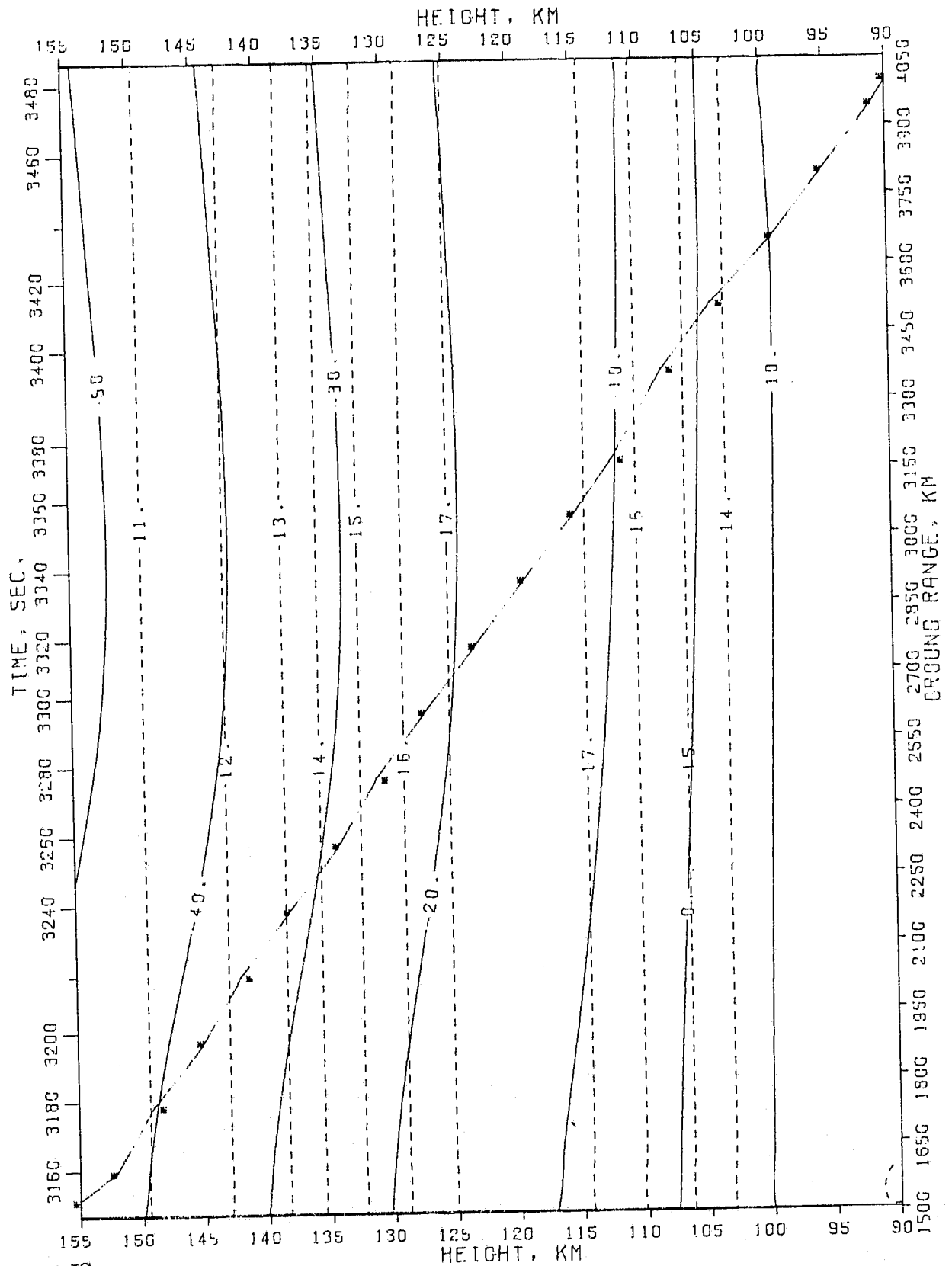
KEY

— PRESSURE, PERCENT DEV. FROM STD. ATM.

- - - STD. DEV. OF PRESSURE

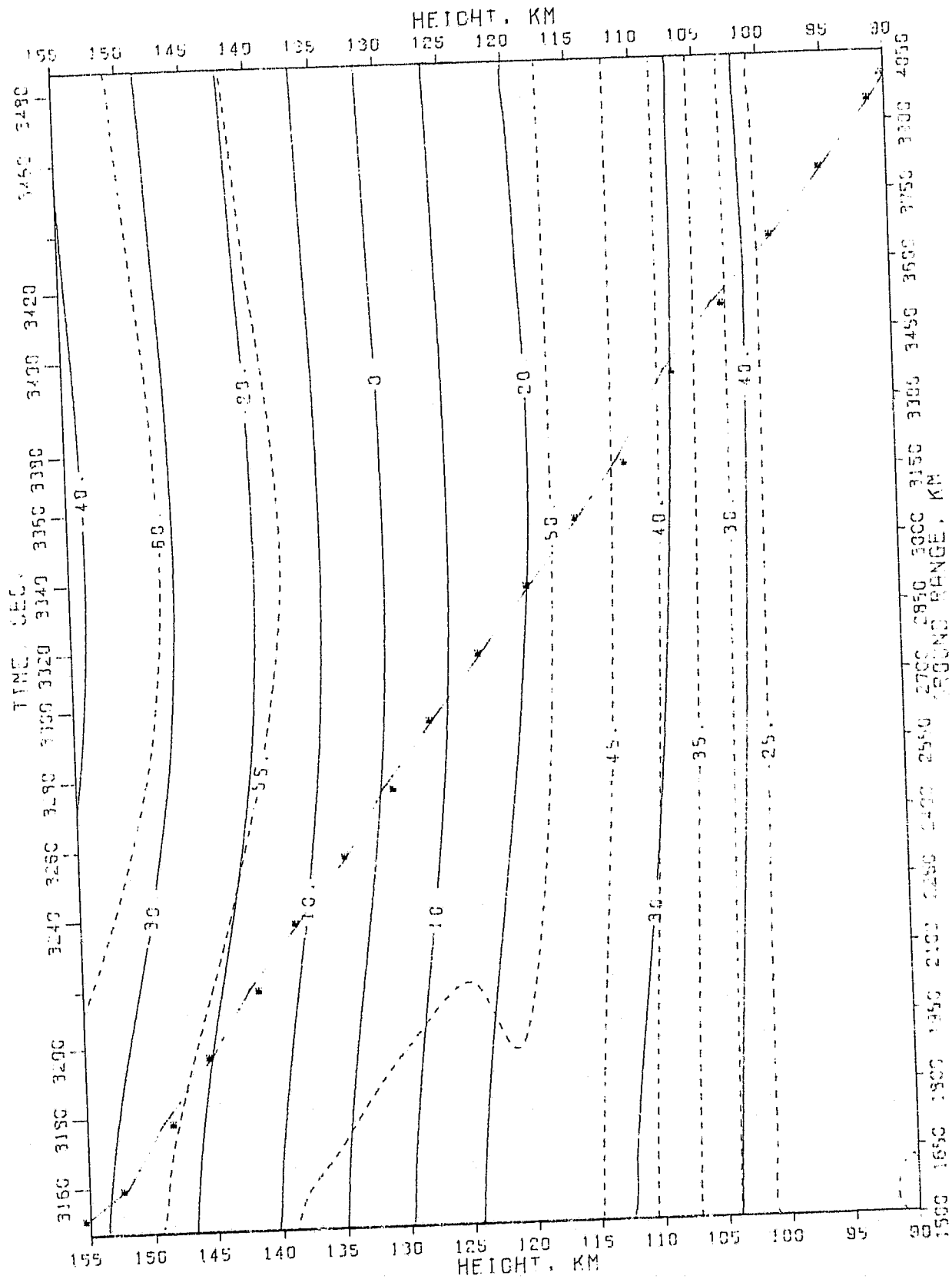
* TRAJECTORY

DURING MONTH OF JANUARY WITH LOW SOLAR ACTIVITY



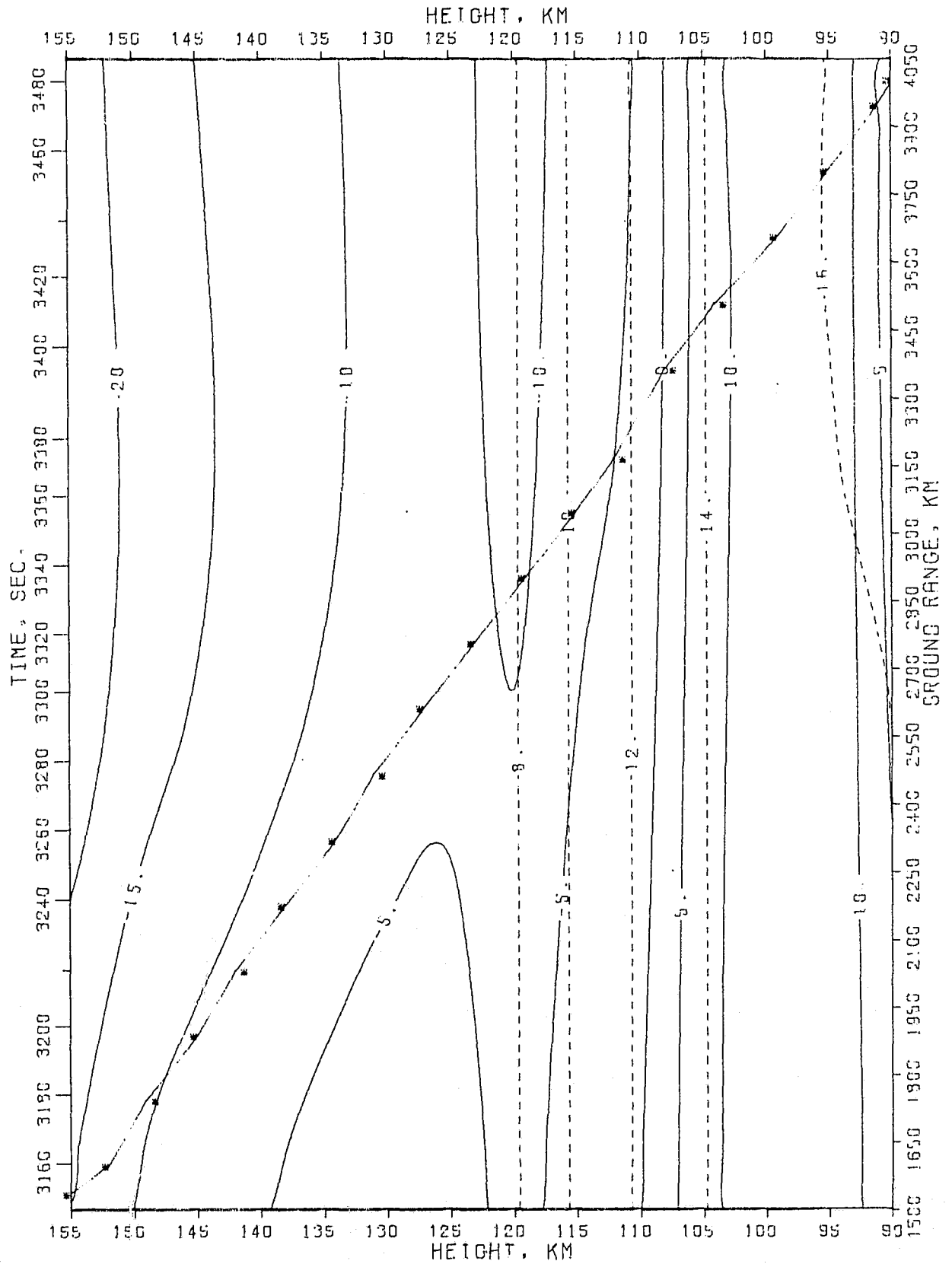
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OF POOR QUALITY

KEY
 --- UPPER 99TH PERCENTILE OF PRESSURE
 --- LOWER 99TH PERCENTILE OF PRESSURE
 * TRAJECTORY
 DURING MONTH OF JANUARY WITH LOW SOLAR ACTIVITY



KEY

- DENSITY PERCENT DEV. FROM STD. ATM.
 - STD. DEV. OF DENSITY
 - *--- TRAJECTORY
- DURING MONTH OF JANUARY WITH LOW SOLAR ACTIVITY



KEY

- UPPER 99TH PERCENTILE OF DENSITY
 - - - LOWER 99TH PERCENTILE OF DENSITY
 * TRAJECTORY

DURING MONTH OF JANUARY WITH LOW SOLAR ACTIVITY

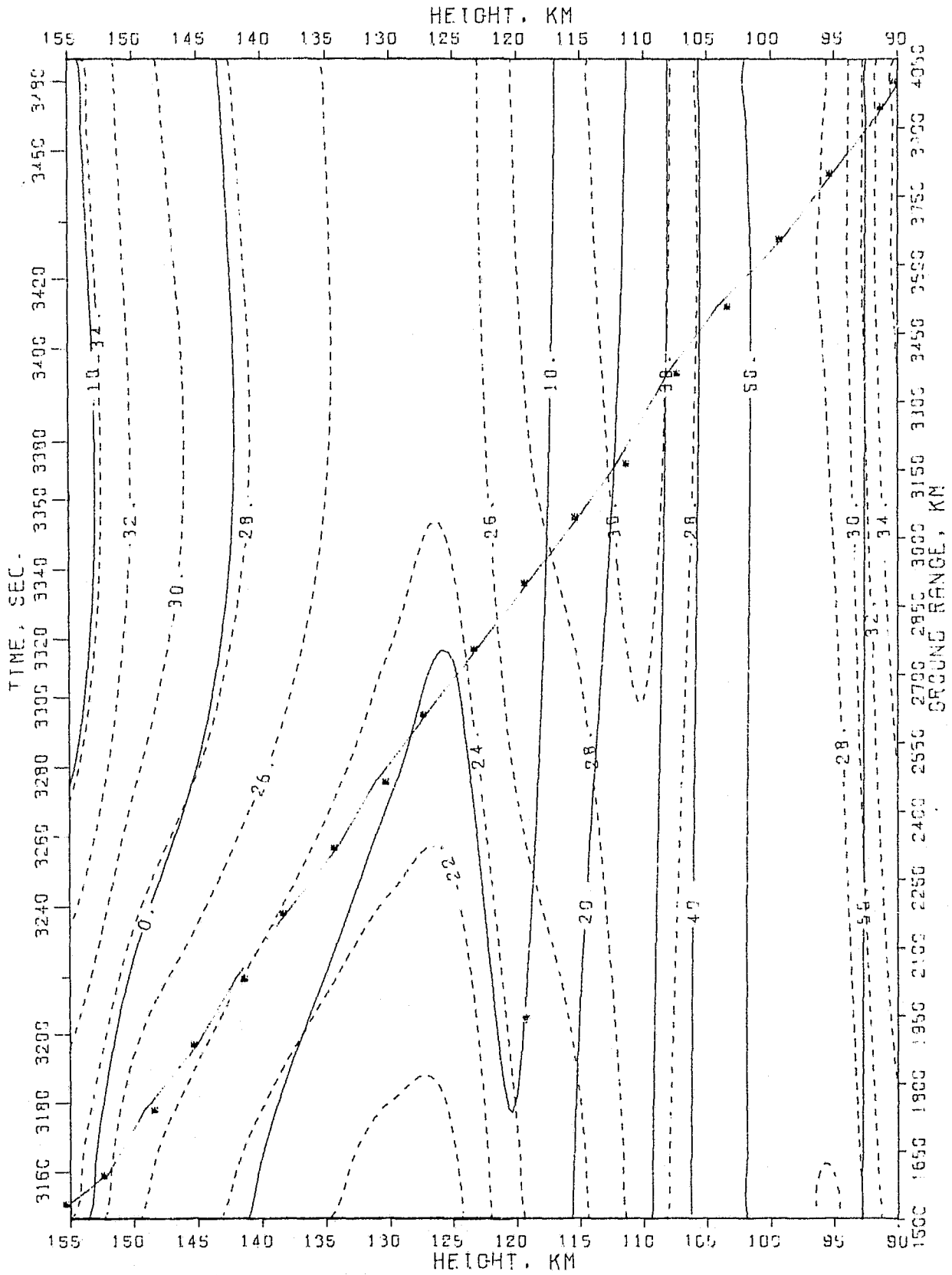
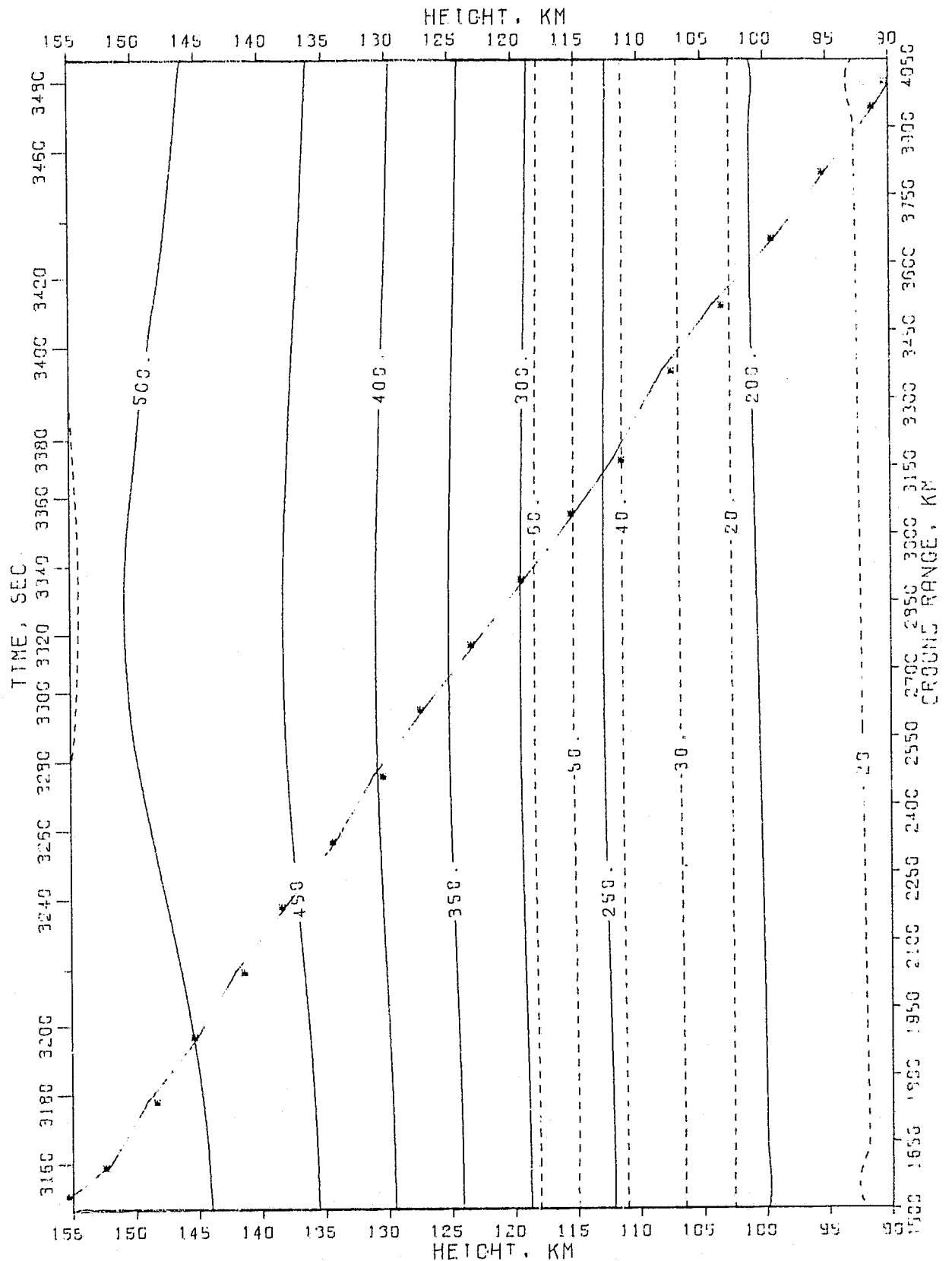


FIG 161

KEY

- TEMPERATURE DEG. K
- - - STD. DEV. OF TEMPERATURE
- * - - - TRAJECTORY

DURING MONTH OF JANUARY WITH LOW SOLAR ACTIVITY



KEY
 ----- UPPER 99TH PERCENTILE OF TEMPERATURE
 ----- LOWER 99TH PERCENTILE OF TEMPERATURE
 - - - - - TRAJECTORY
 DURING MONTH OF JANUARY WITH LOW SOLAR ACTIVITY

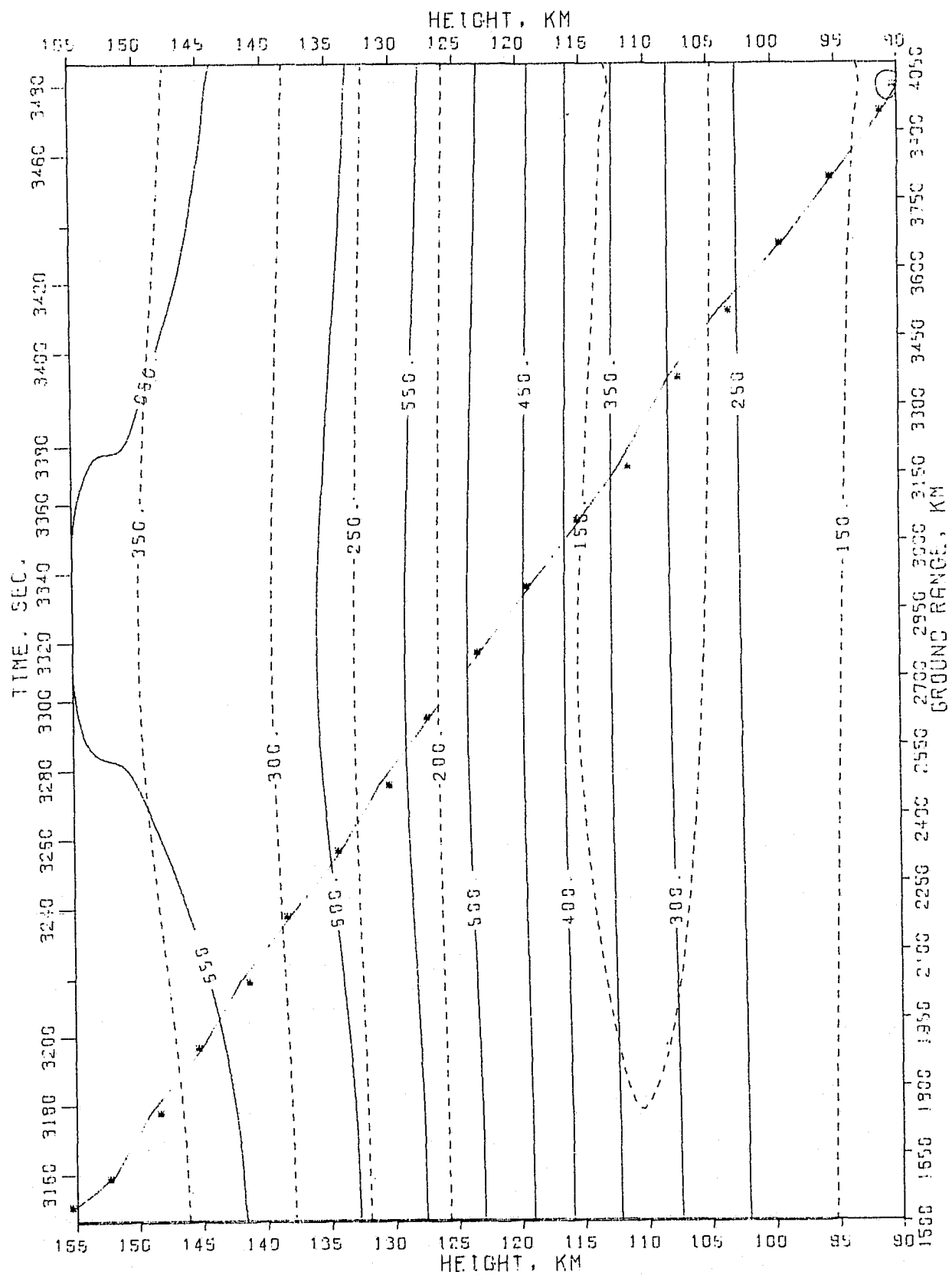


FIG 163

KEY
 ——— PRESSURE, PERCENT DEV. FROM STD. ATM.
 - - - STD. DEV. OF PRESSURE
 * TRAJECTORY
 DURING MONTH OF APRIL

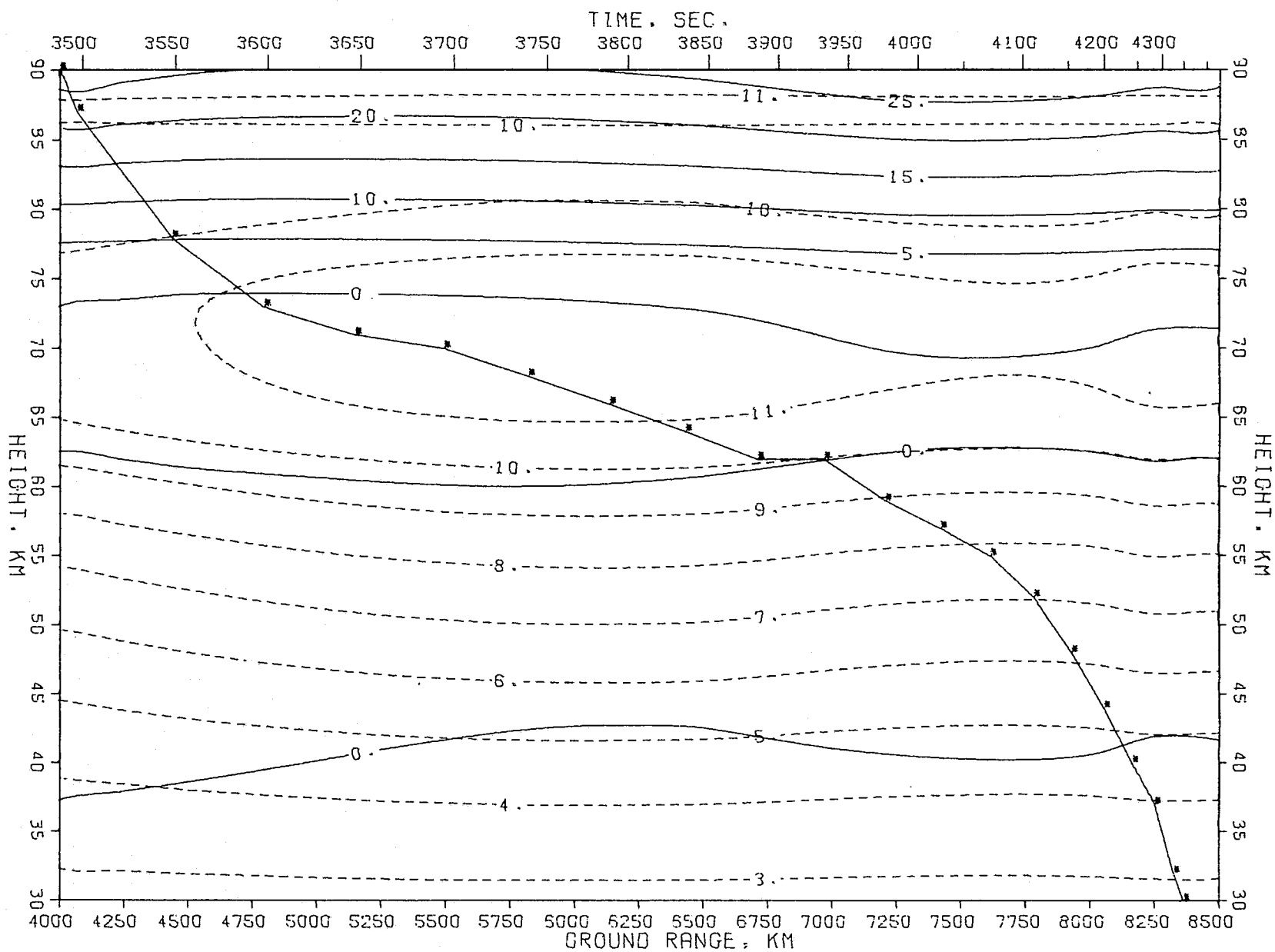


FIG 164

KEY

- UPPER 99TH PERCENTILE OF PRESSURE
 - - - - LOWER 99TH PERCENTILE OF PRESSURE
 - *— TRAJECTORY
- DURING MONTH OF APRIL

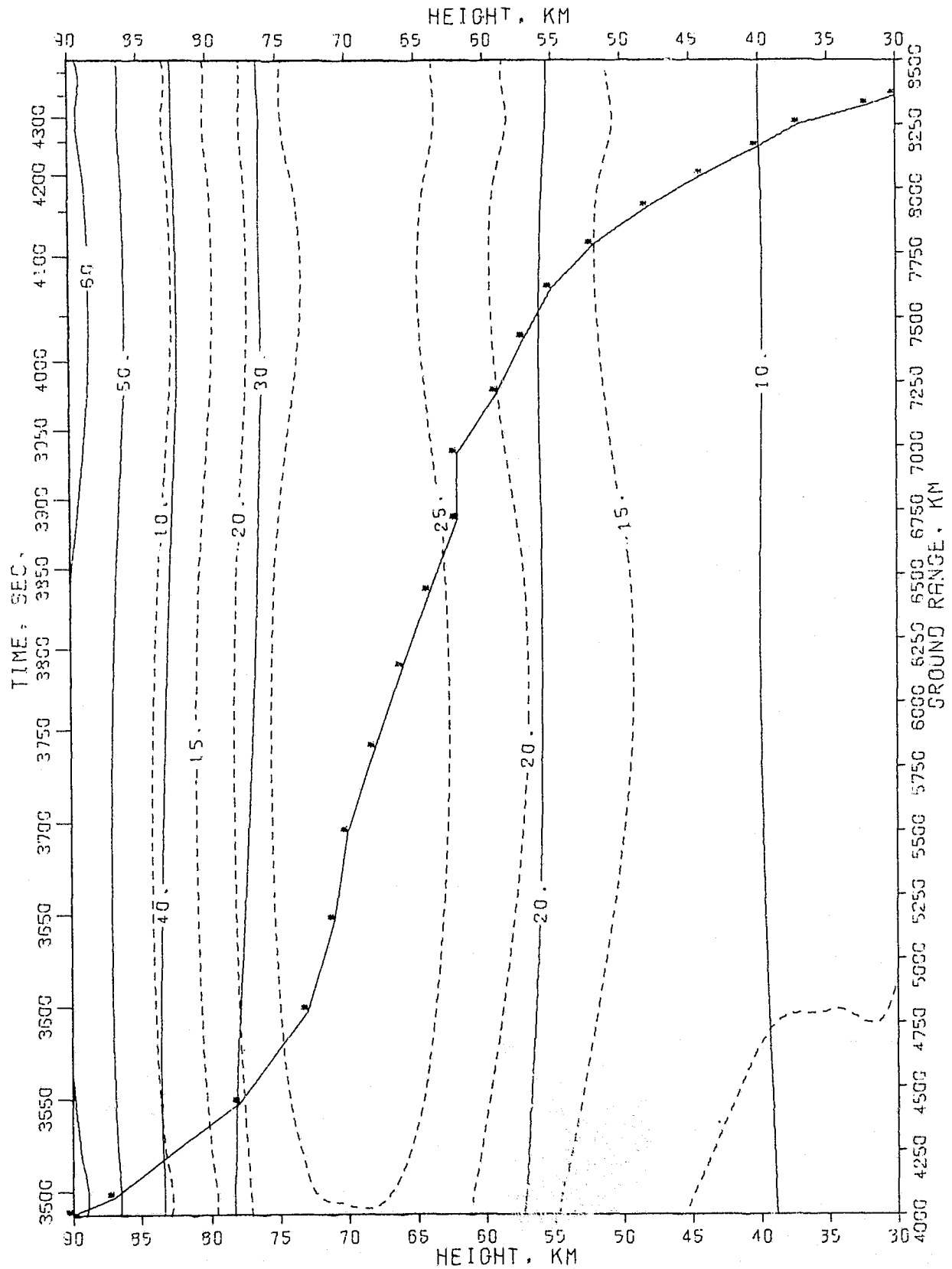


FIG 165

KEY
 — DENSITY PERCENT DEV. FROM STD. ATM.
 - - - STD. DEV. OF DENSITY
 * TRAJECTORY
 DURING MONTH OF APRIL

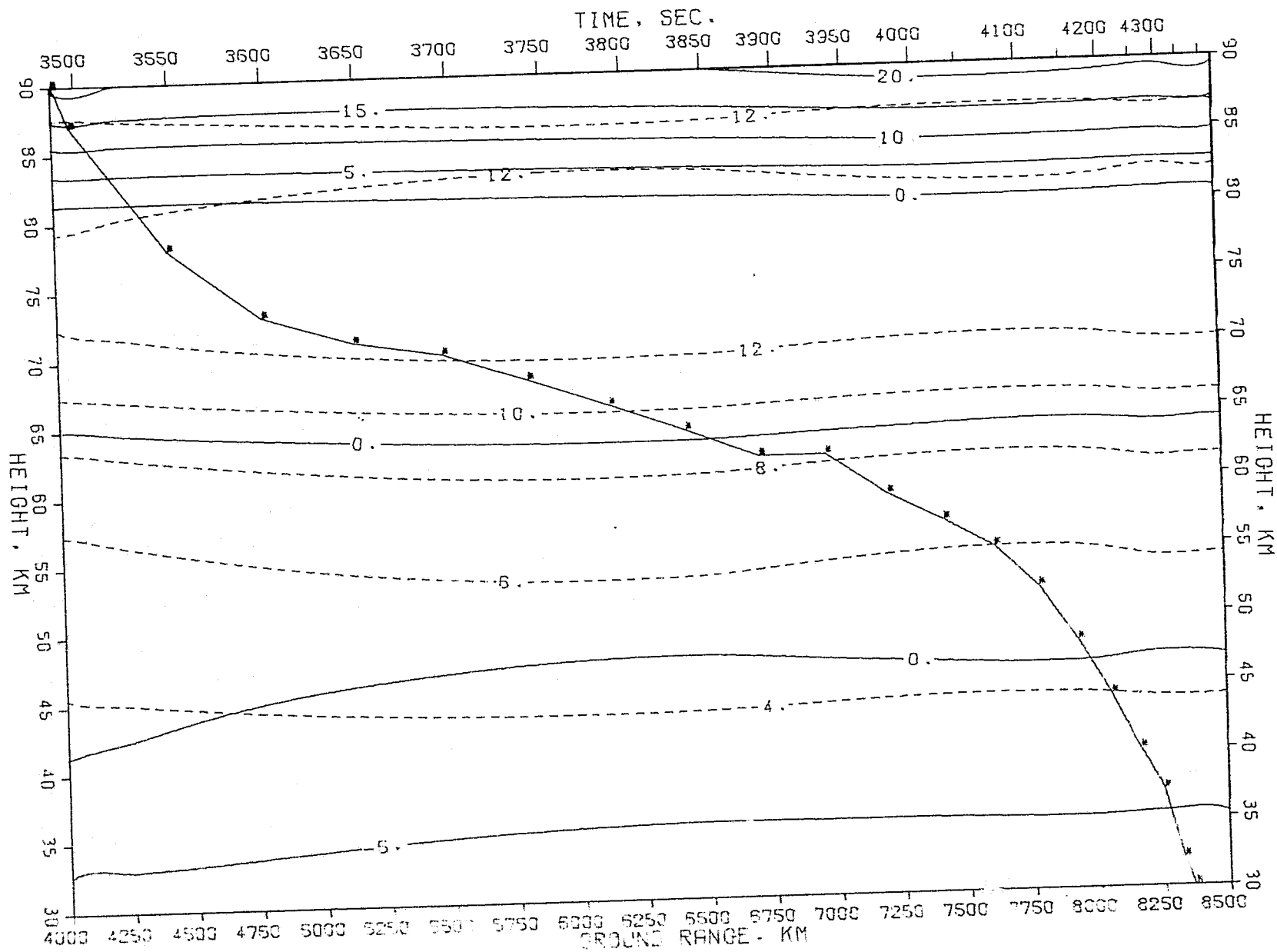


FIG 166

KEY
 — UPPER 99TH PERCENTILE OF DENSITY
 - - - LOWER 99TH PERCENTILE OF DENSITY
 * TRAJECTORY
 DURING MONTH OF APRIL

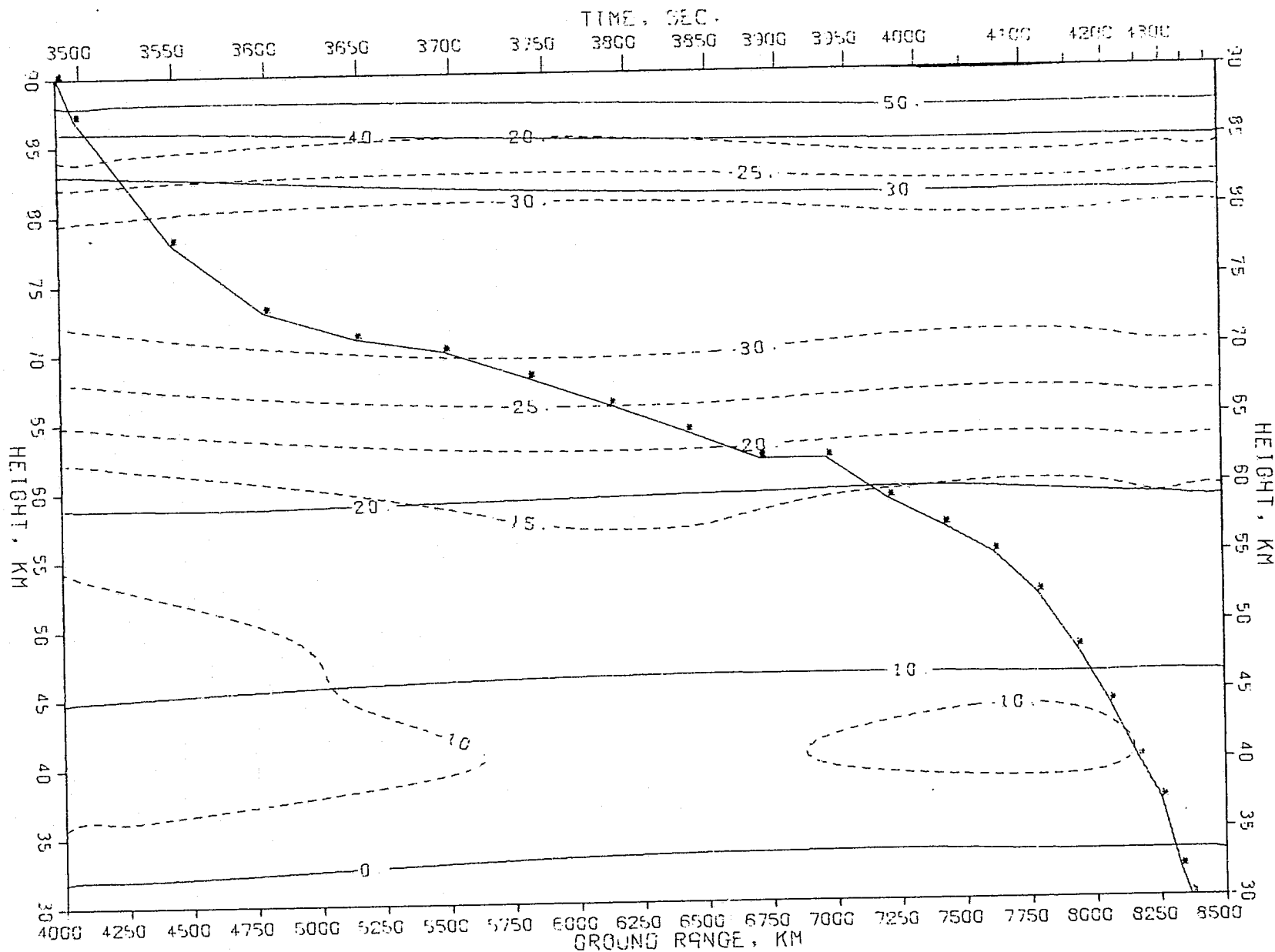
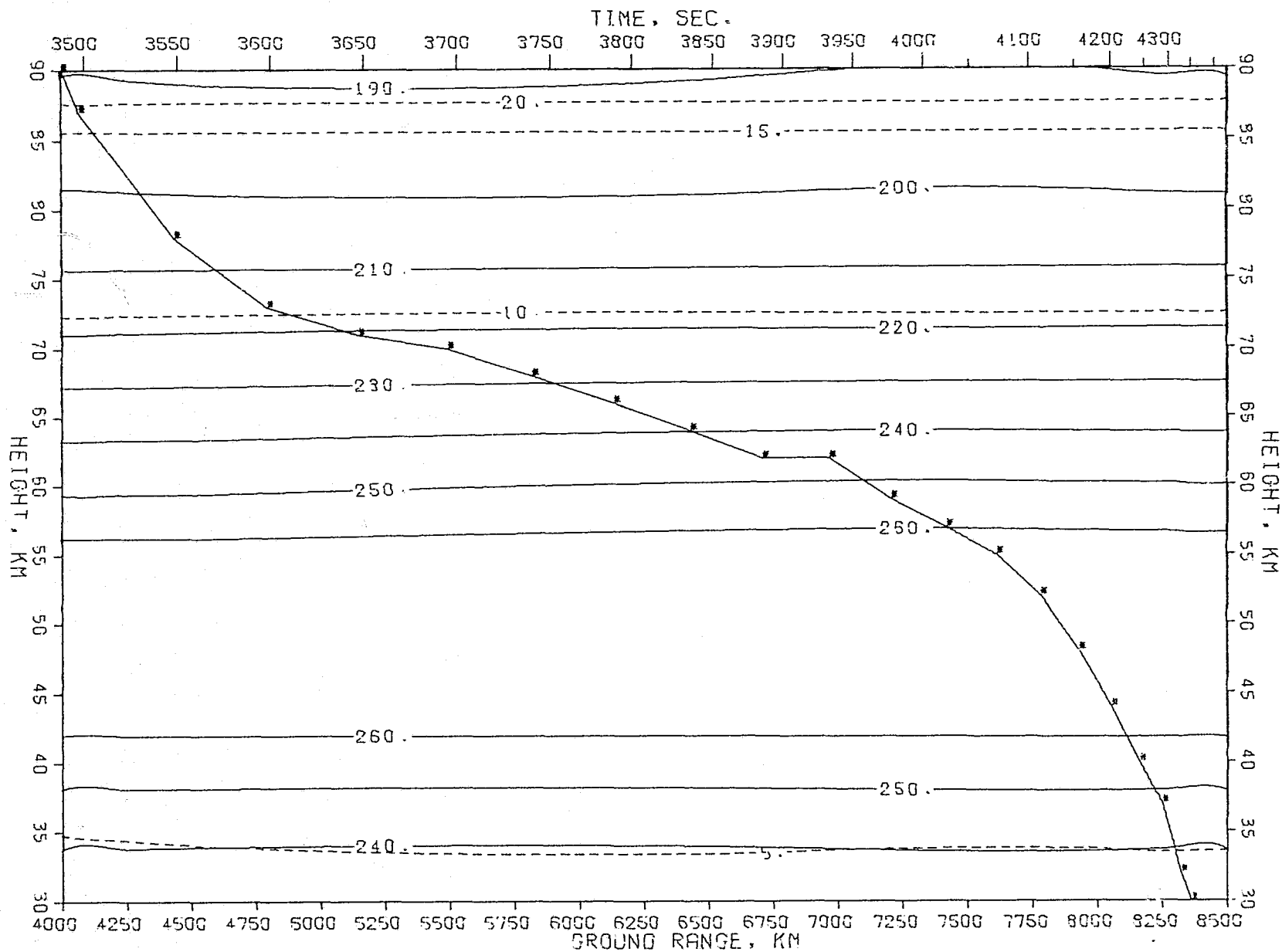


FIG 167

KEY

— TEMPERATURE DEG. K
 - - - STD. DEV. OF TEMPERATURE
 * TRAJECTORY
 DURING MONTH OF APRIL.



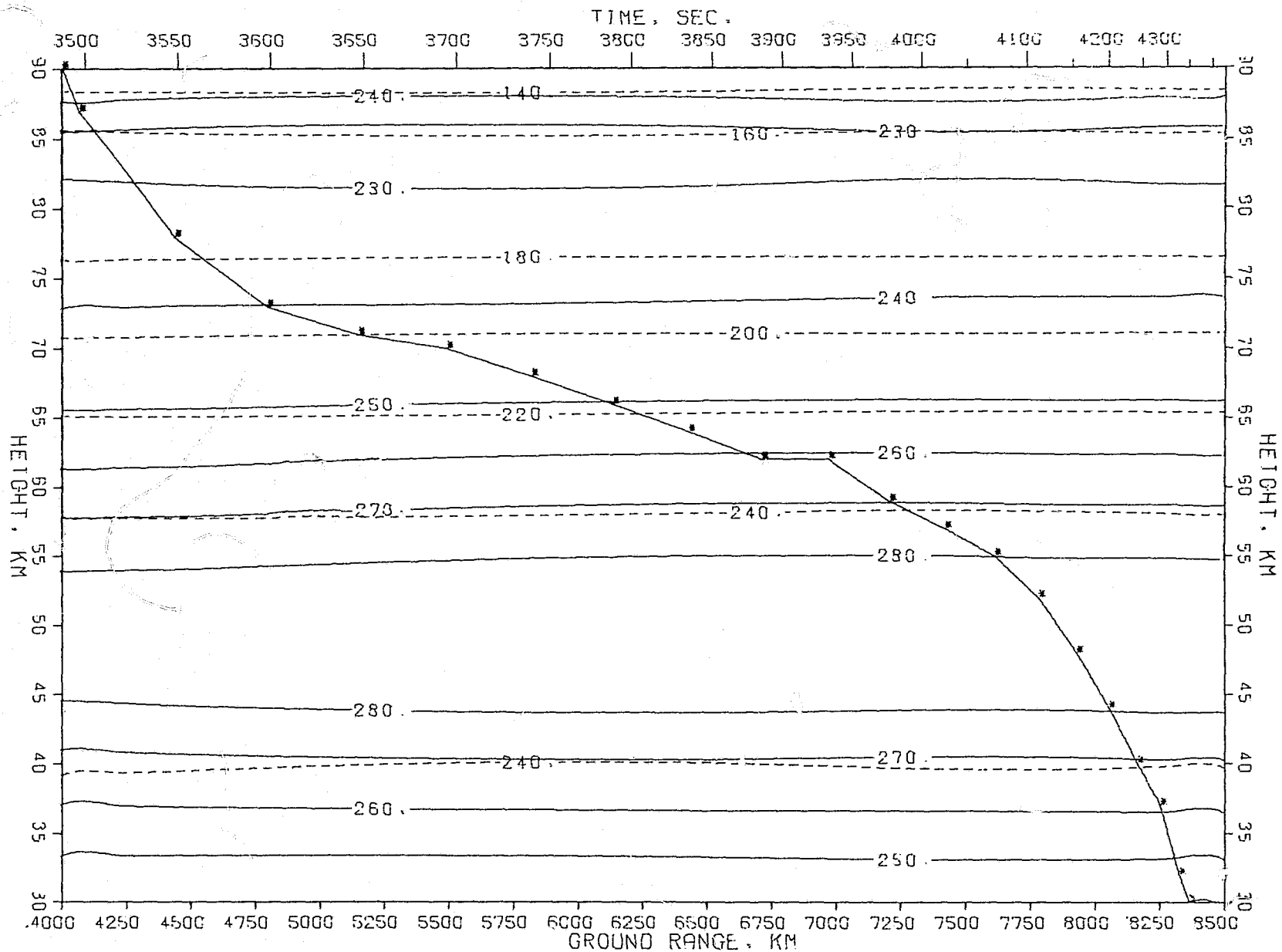
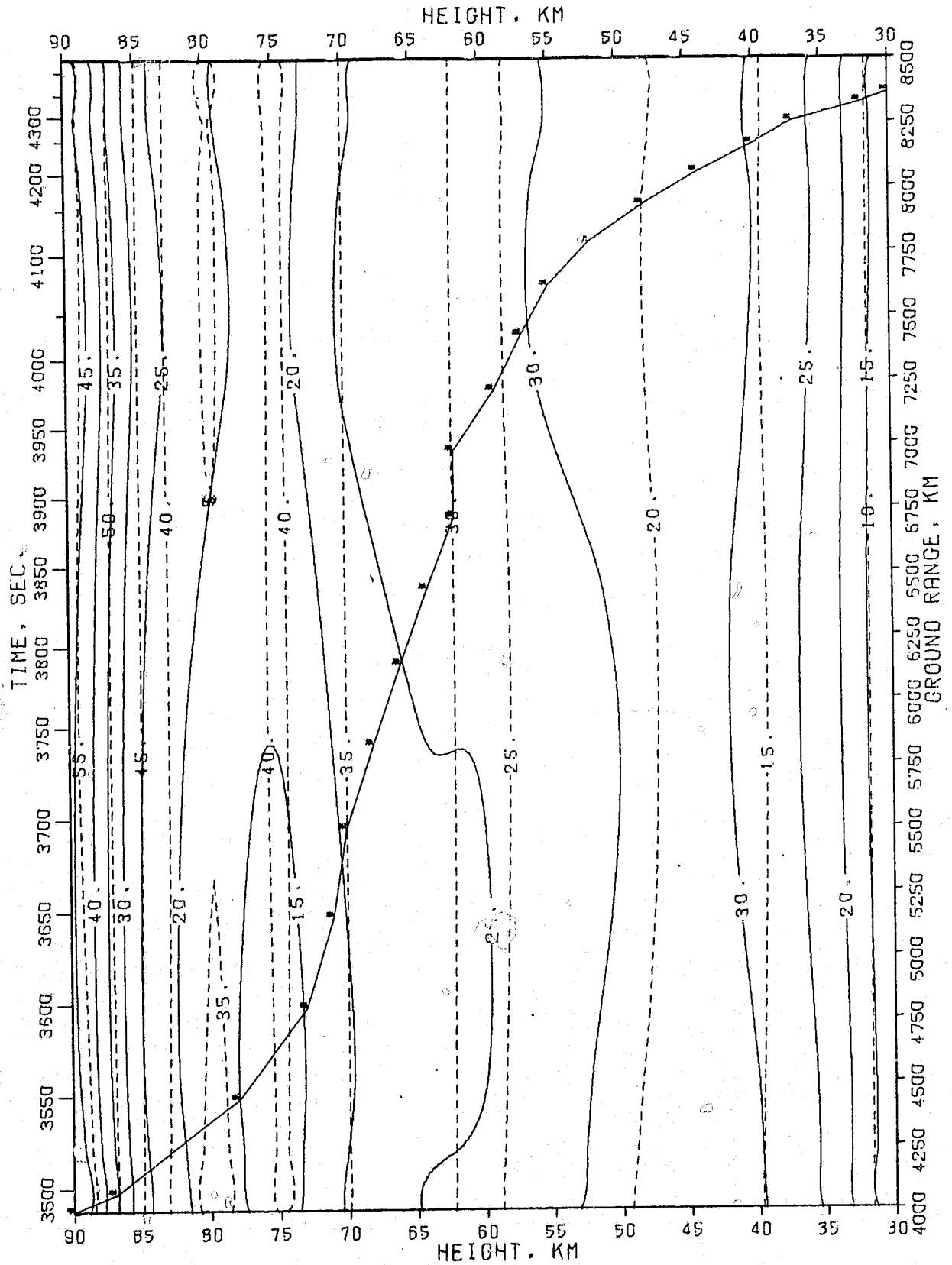


FIG 169

KEY

- EASTWARD WIND GEOSTROPHIC MONTHLY MEAN. M/S.
- - - STD. DEV. OF EASTWARD WIND
- TRAJECTORY
- DURING MONTH OF APRIL



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FIG 170

KEY

- UPPER 99TH PERCENTILE OF EASTWARD WIND
- LOWER 99TH PERCENTILE OF EASTWARD WIND
- TRAJECTORY
- DURING MONTH OF APRIL

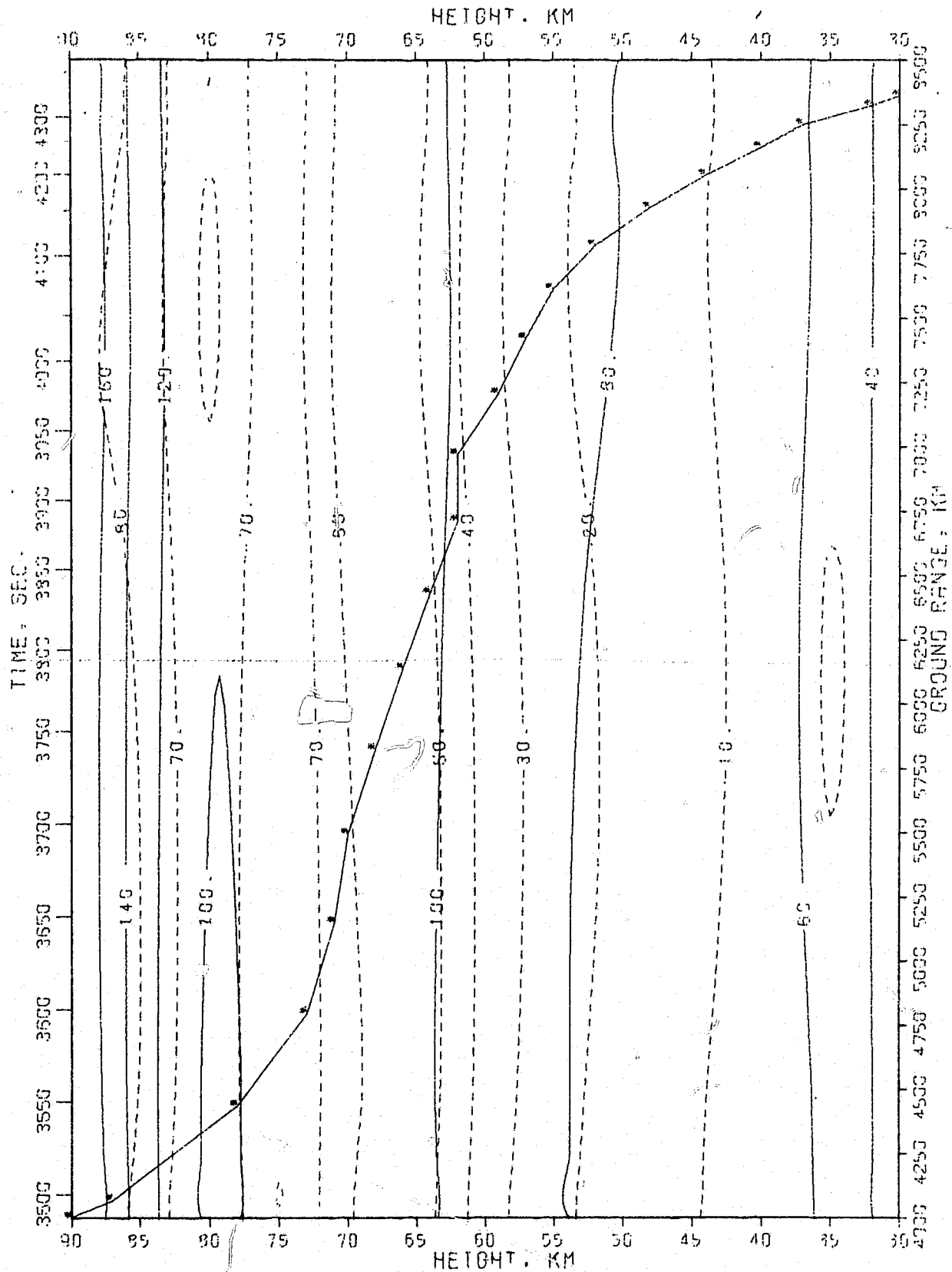
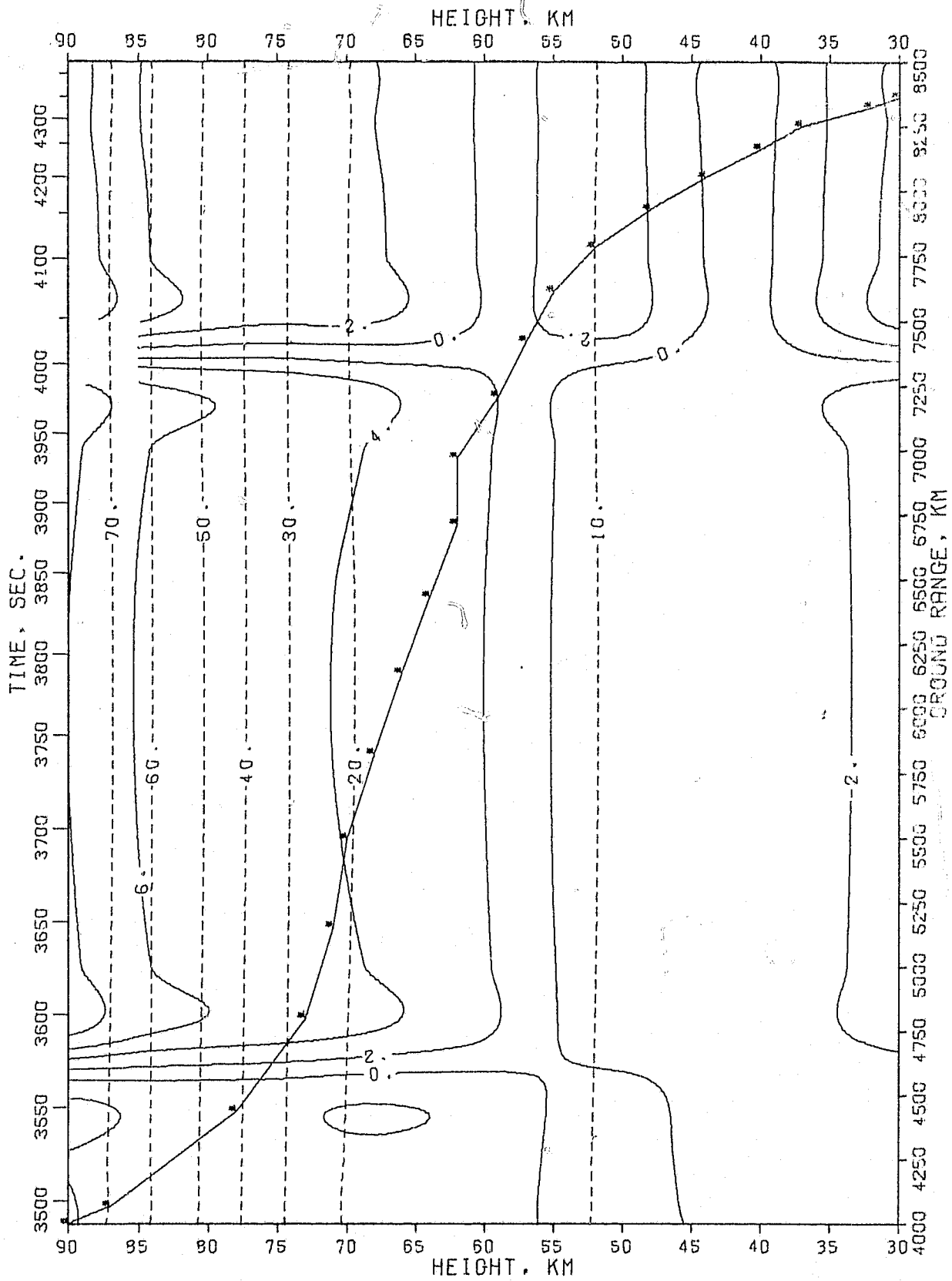


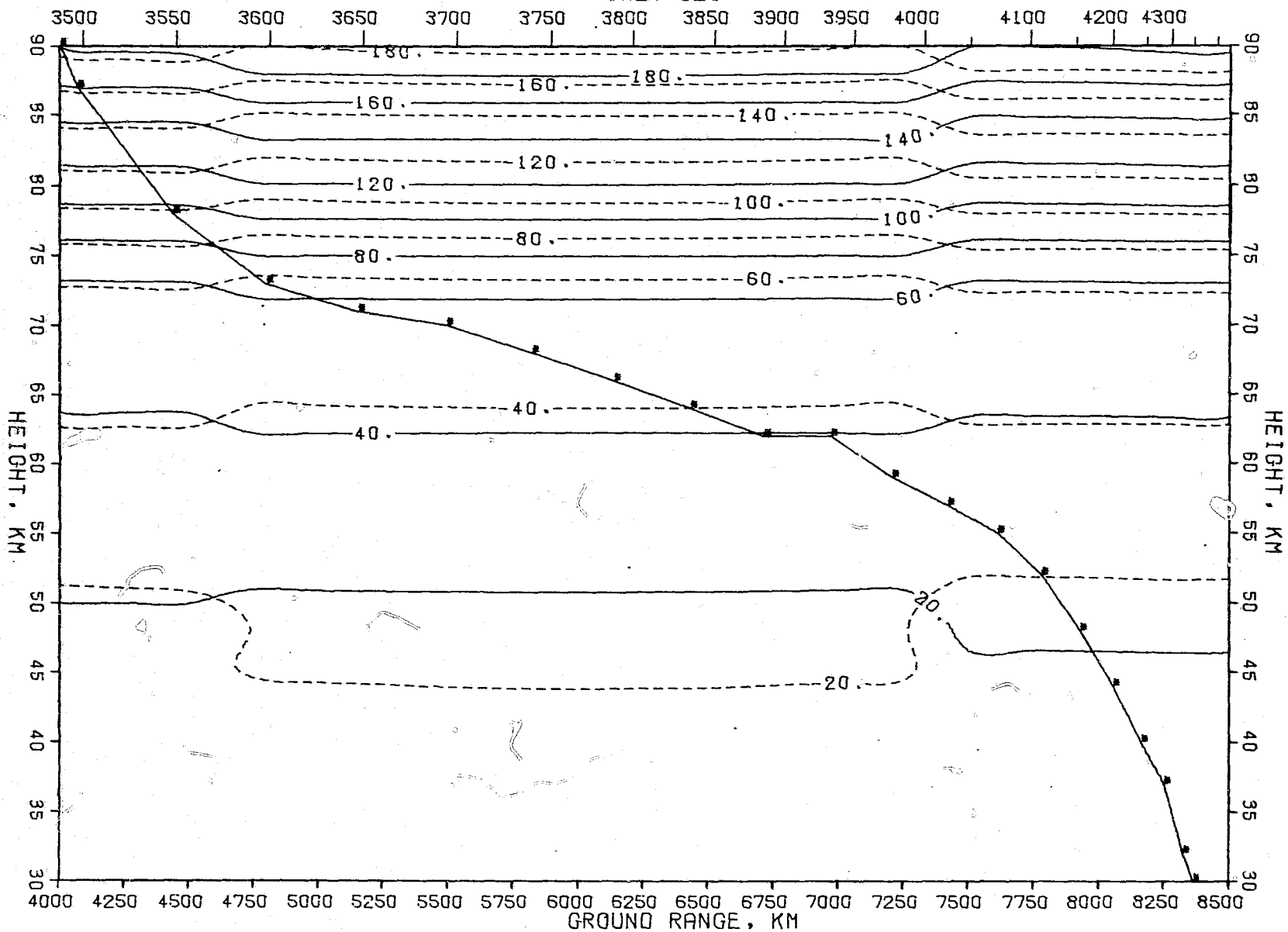
FIG. 171

KEY

_____ NORTHWARD WIND GEOSTROPHIC MONTHLY MEAN, M/S
 ----- STD. DEV. OF NORTHWARD WIND
 AT _____ * TRAJECTORY
 DURING MONTH OF APRIL



TIME, SEC.



KEY

— UPPER 99TH PERCENTILE OF NORTHWARD WIND
 --- LOWER 99TH PERCENTILE OF NORTHWARD WIND
 * TRAJECTORY
 DURING MONTH OF APRIL

FIG 172

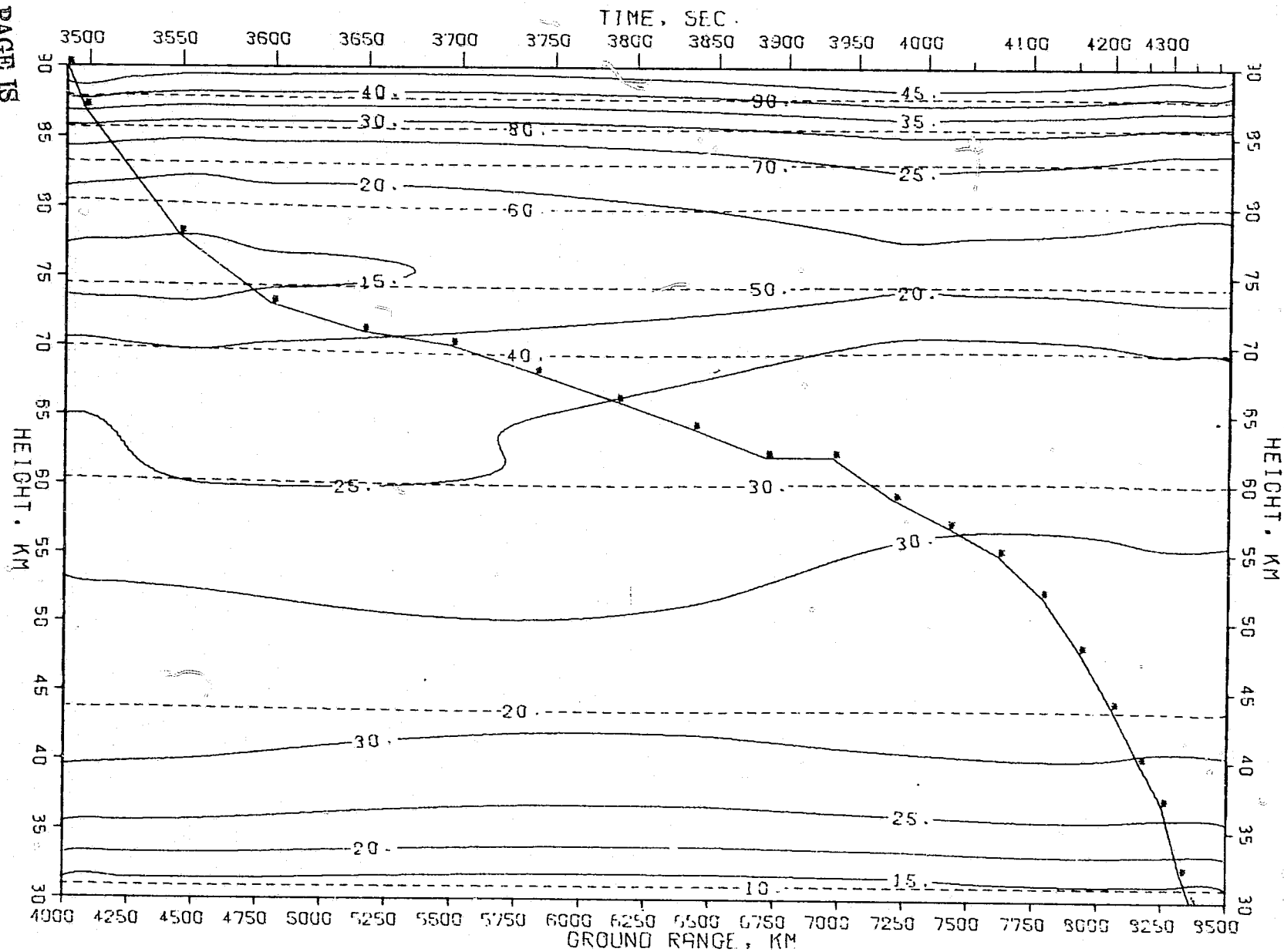


FIG 173

FIG 174

KFY

— UPPER 99TH PERCENTILE OF WIND SPEED
 --- LOWER 99TH PERCENTILE OF WIND SPEED
 * TRAJECTORY
 DURING MONTH OF APRIL

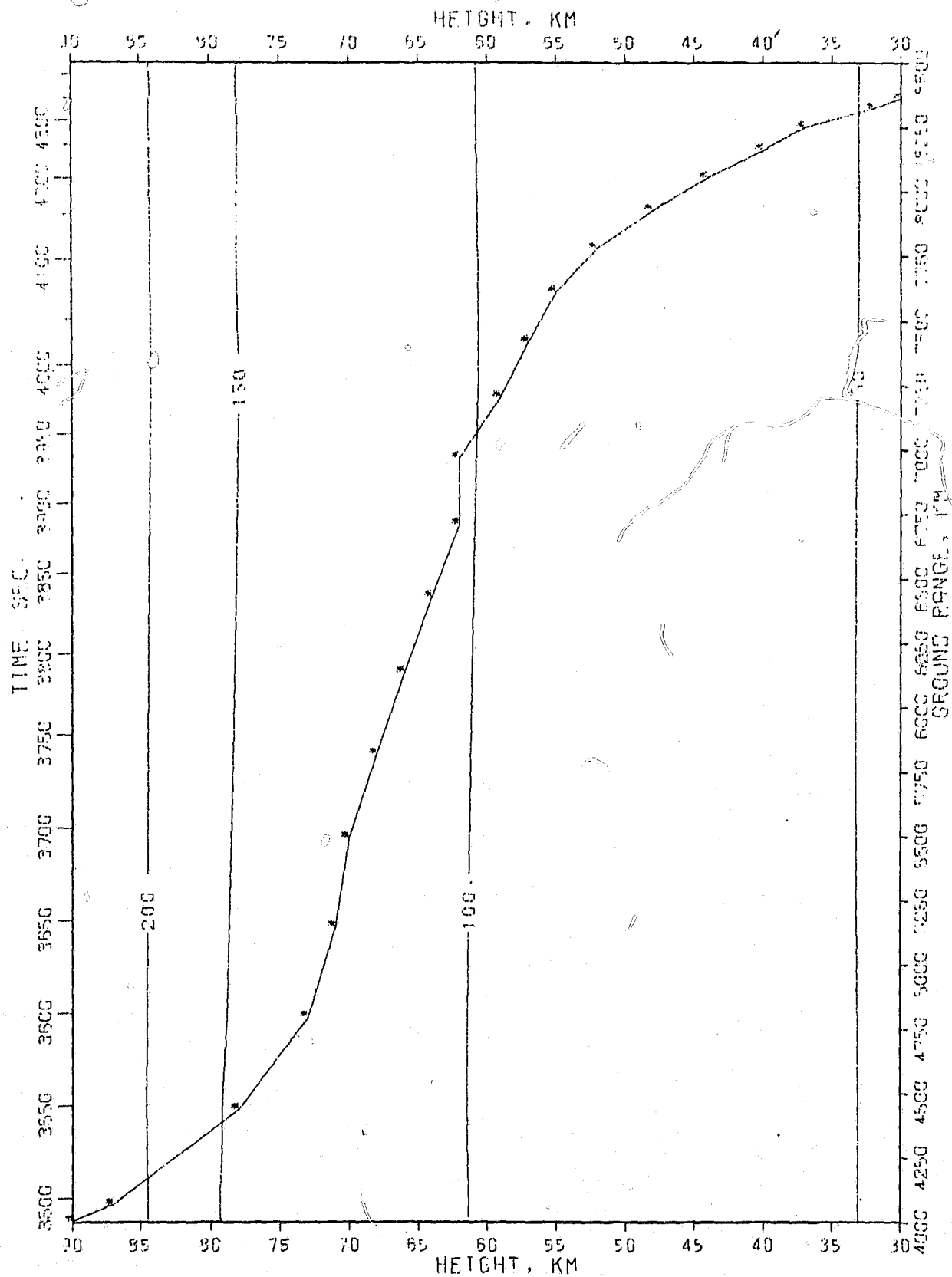
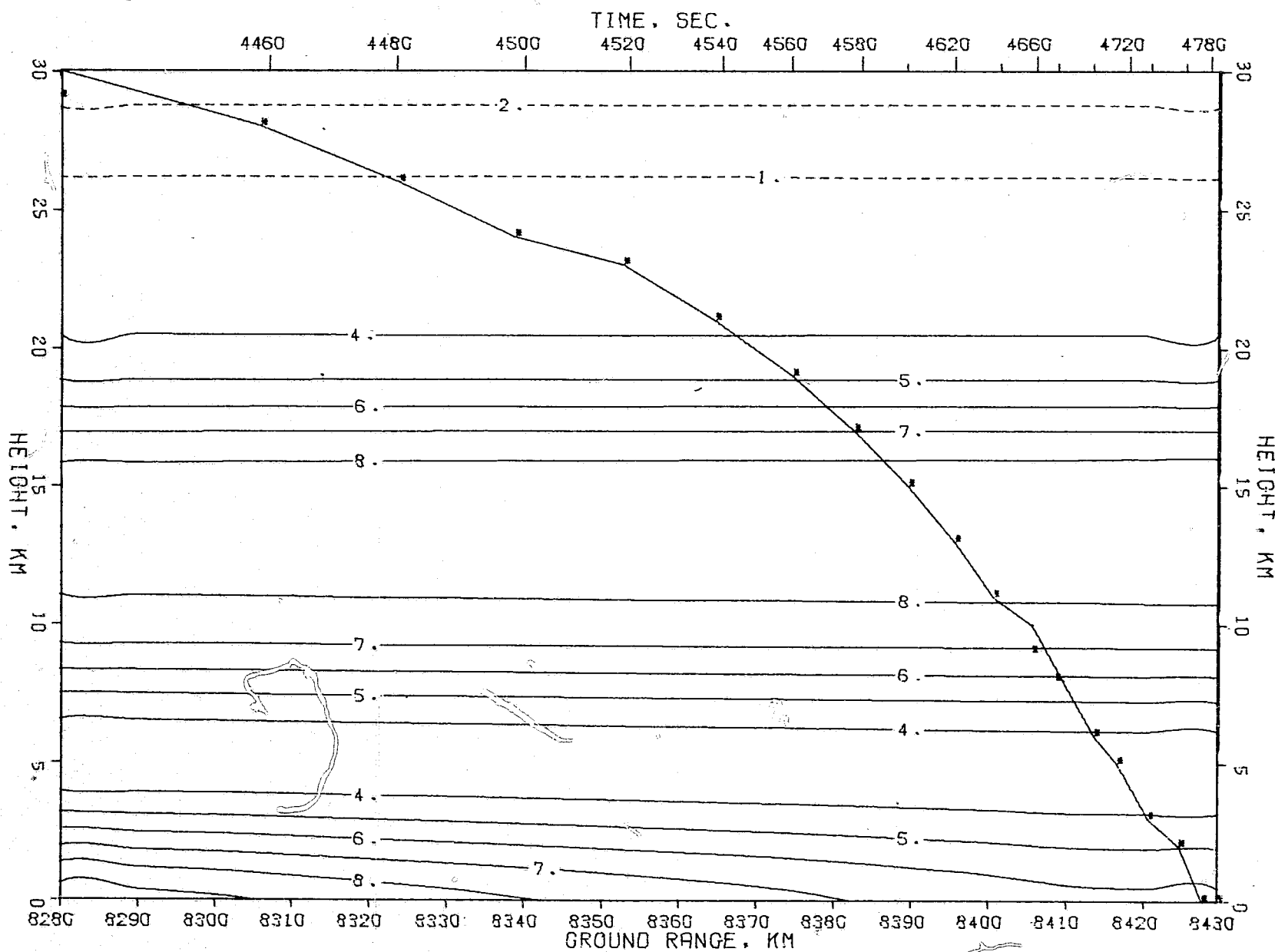


FIG 175

KEY
 ——— PRESSURE, PERCENT DEV. FROM STD. ATM.
 - - - STD. DEV. OF PRESSURE
 ——— TRAJECTORY
 ■ DURING MONTH OF JULY



KF7

— UPPER 99TH PERCENTILE OF PRESSURE
 - - - LOWER 99TH PERCENTILE OF PRESSURE
 * * * TRAJECTORY
 DURING MONTH OF JULY

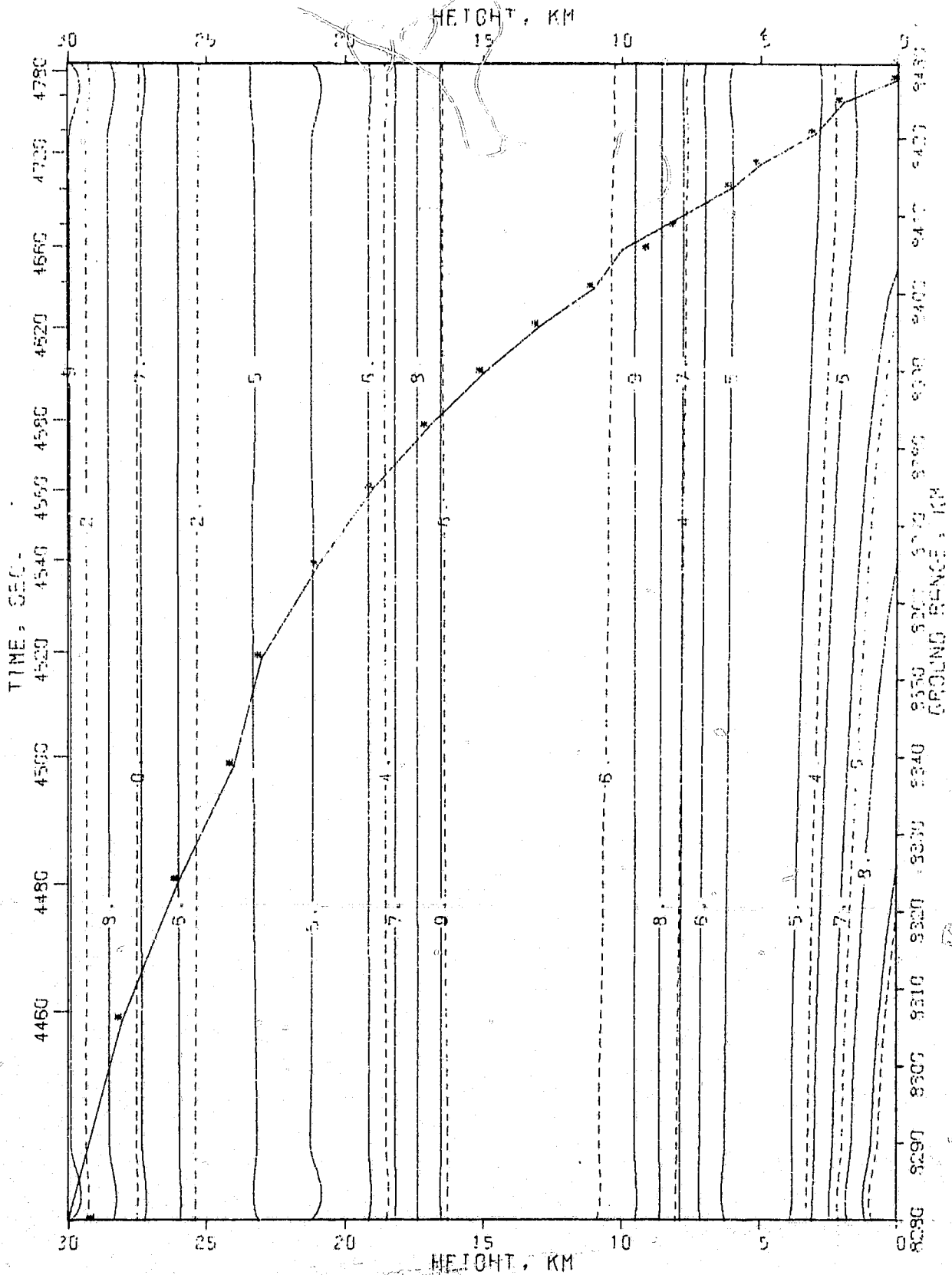


FIG 177

KEY

- DENSITY PERCENT DEV. FROM STD. ATM.
- - - STD. DEV. OF DENSITY
- TRAJECTORY
- DURING MONTH OF JULY

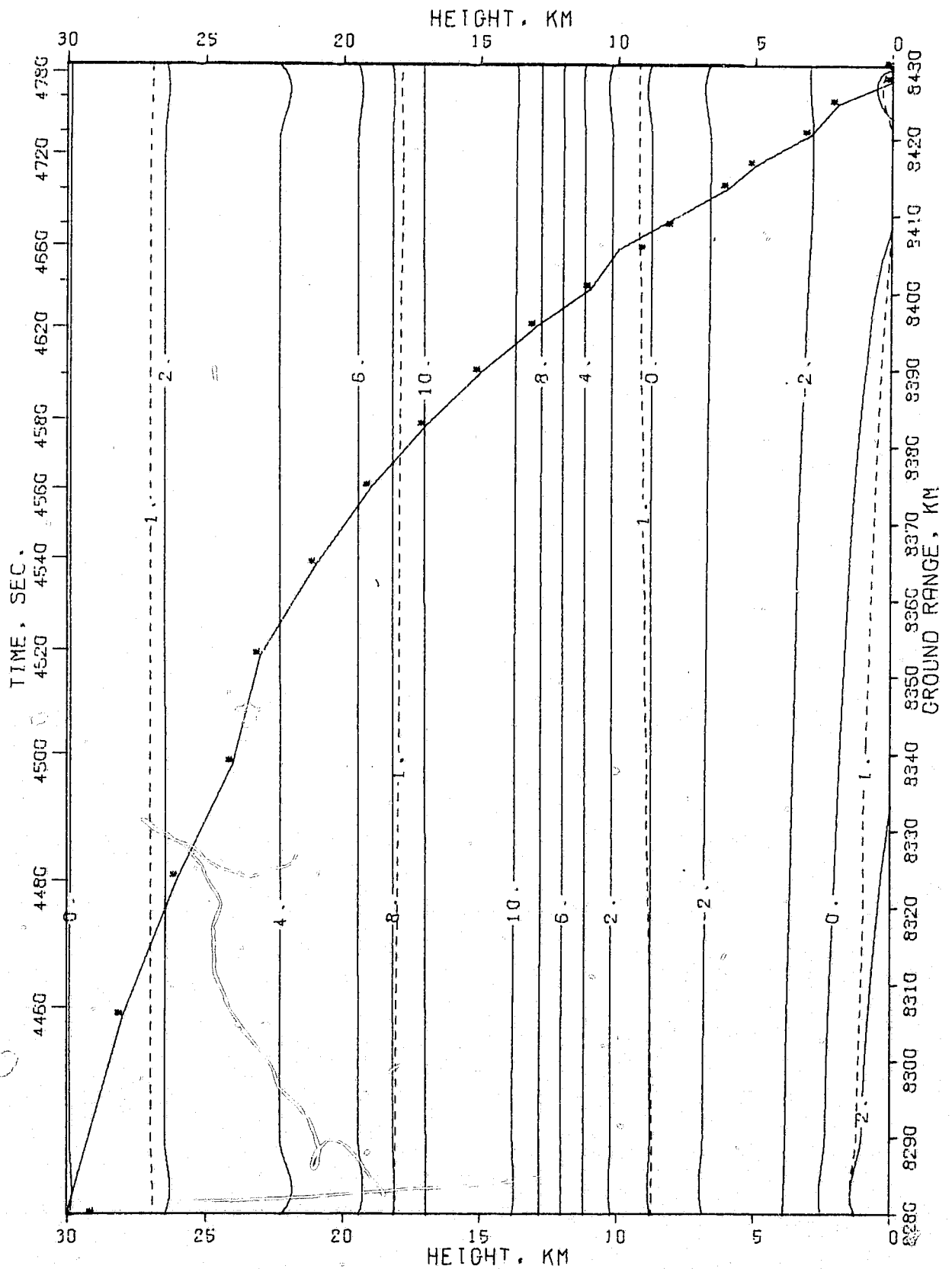


FIG 178

KEY

- UPPER 99TH PERCENTILE OF DENSITY
 - LOWER 99TH PERCENTILE OF DENSITY
 - *--- TRAJECTORY
- DURING MONTH OF JULY

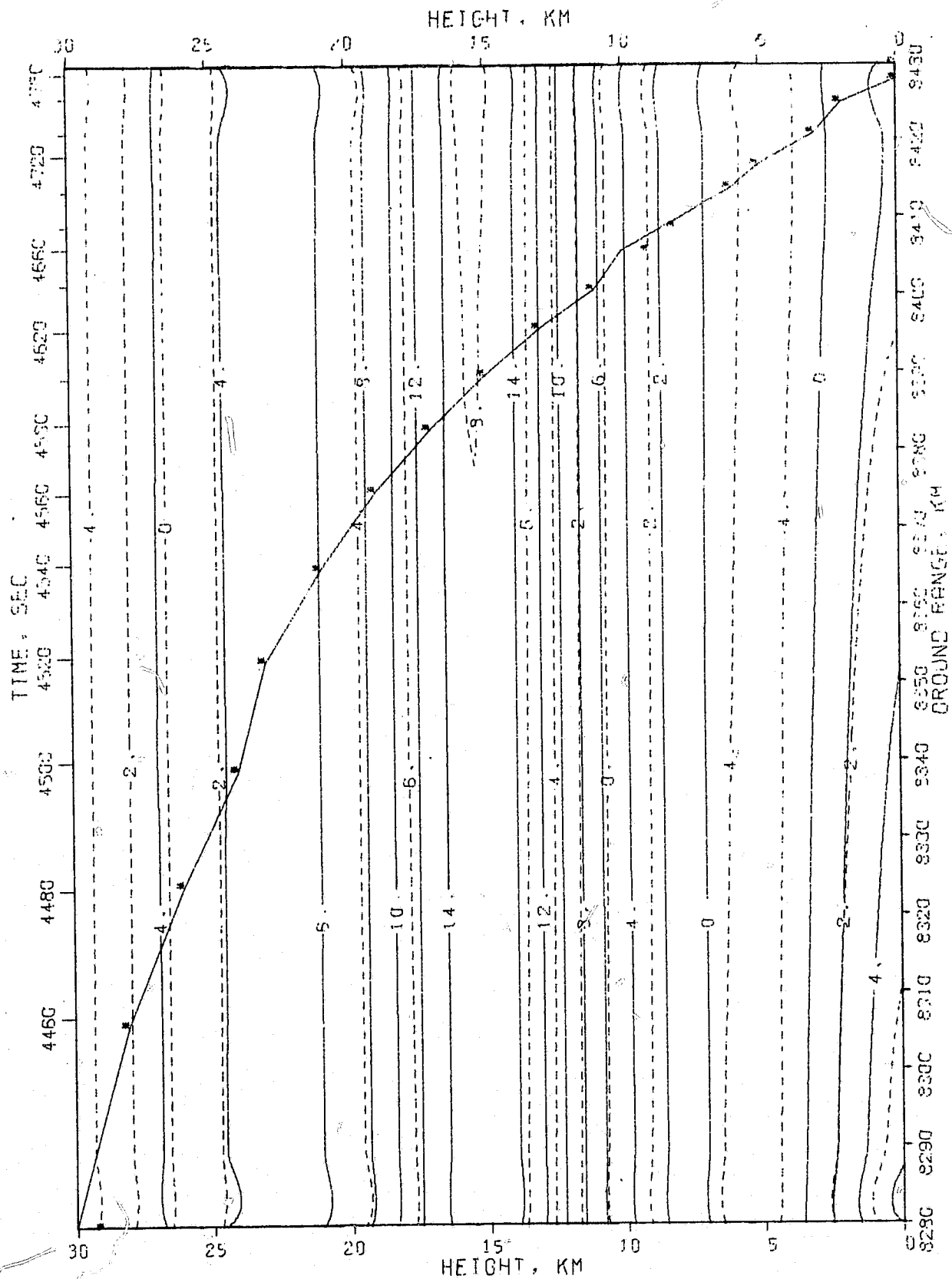


FIG 179

KEY

— TEMPERATURE DEG. K
 - - - STD. DEV. OF TEMPERATURE
 — TRAJECTORY
 DURING MONTH OF JULY

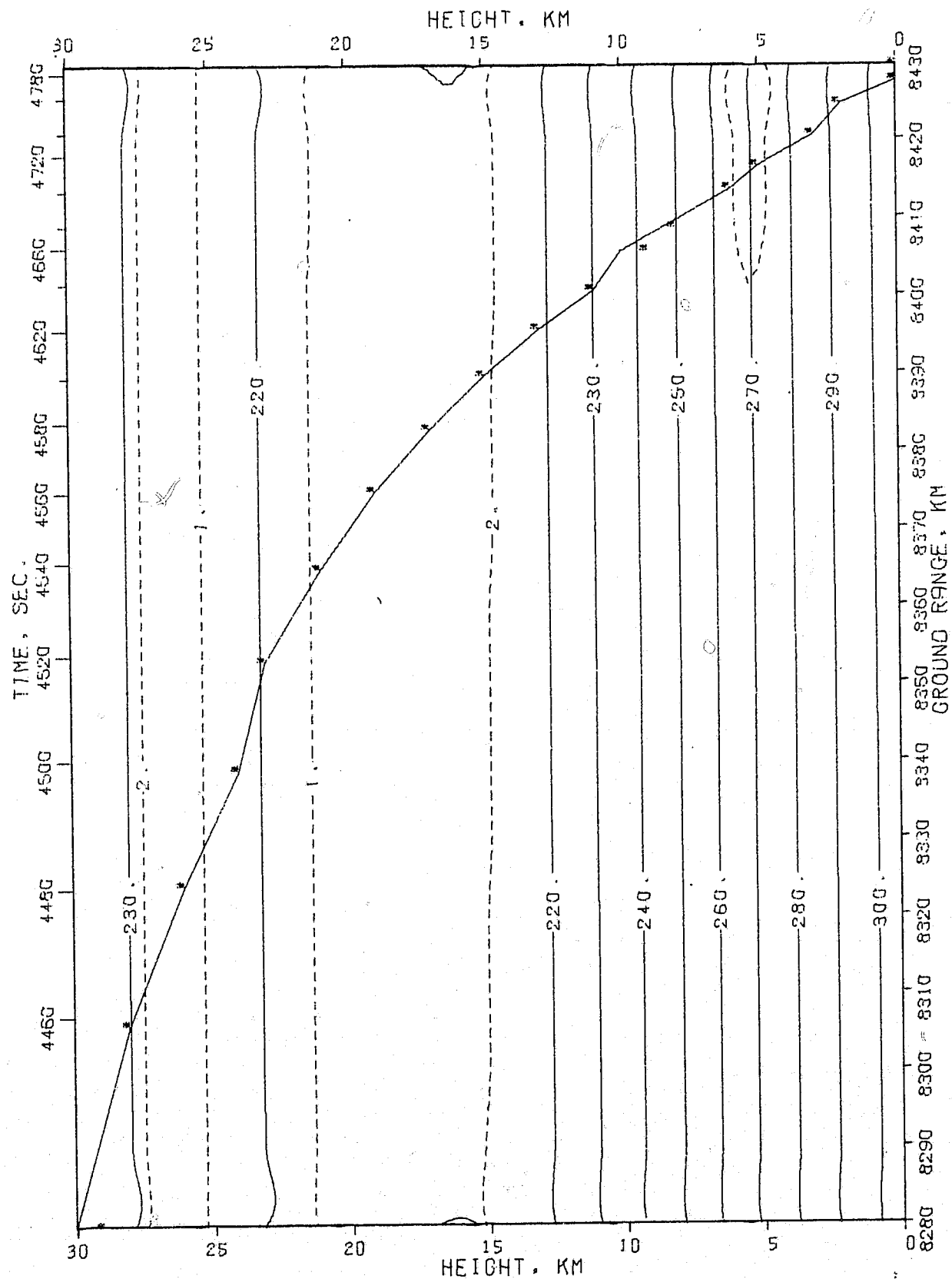


FIG 180

KEY
 — UPPER 99TH PERCENTILE OF TEMPERATURE
 - - - LOWER 99TH PERCENTILE OF TEMPERATURE
 * TRAJECTORY
 DURING MONTH OF JULY

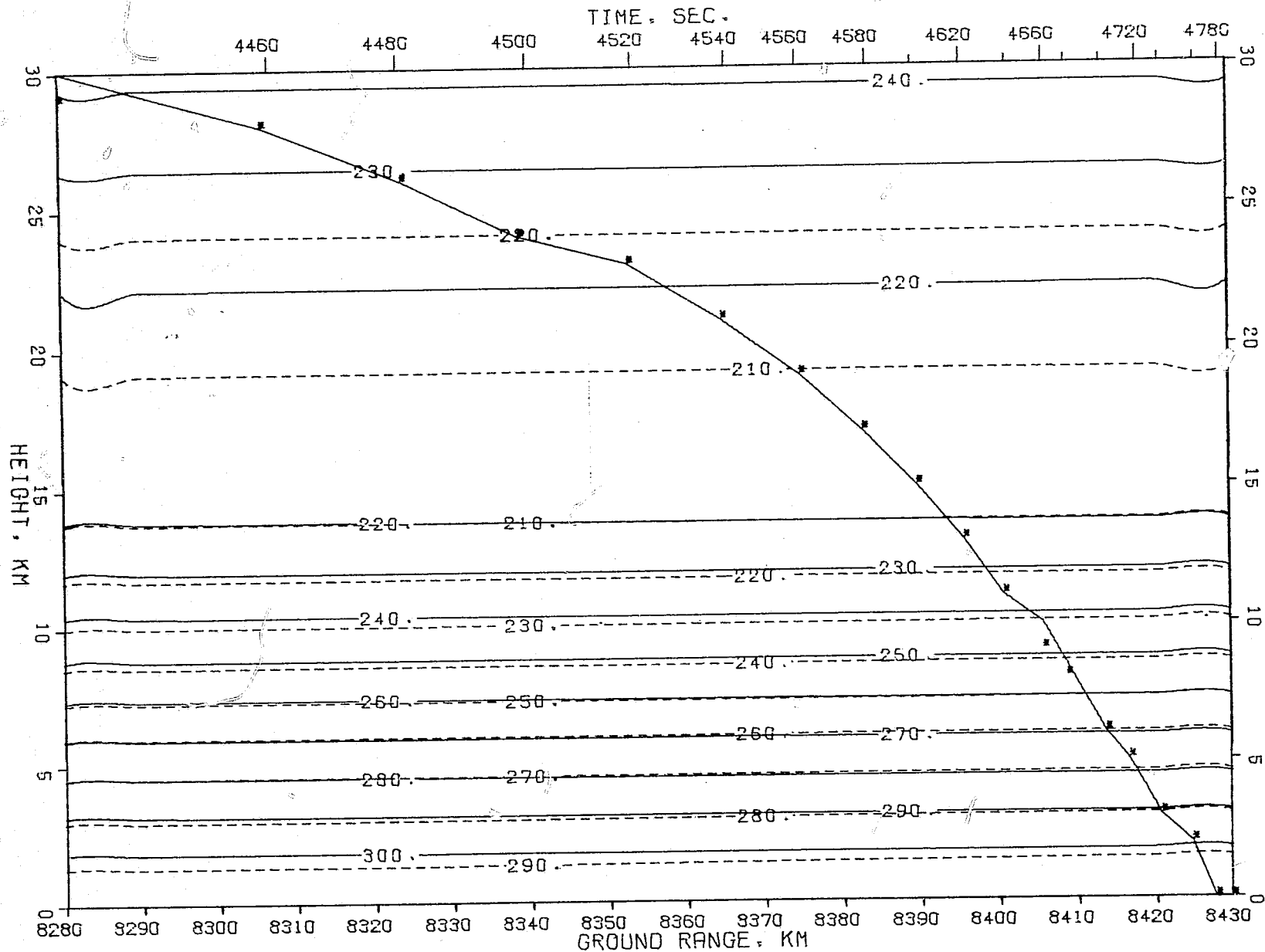
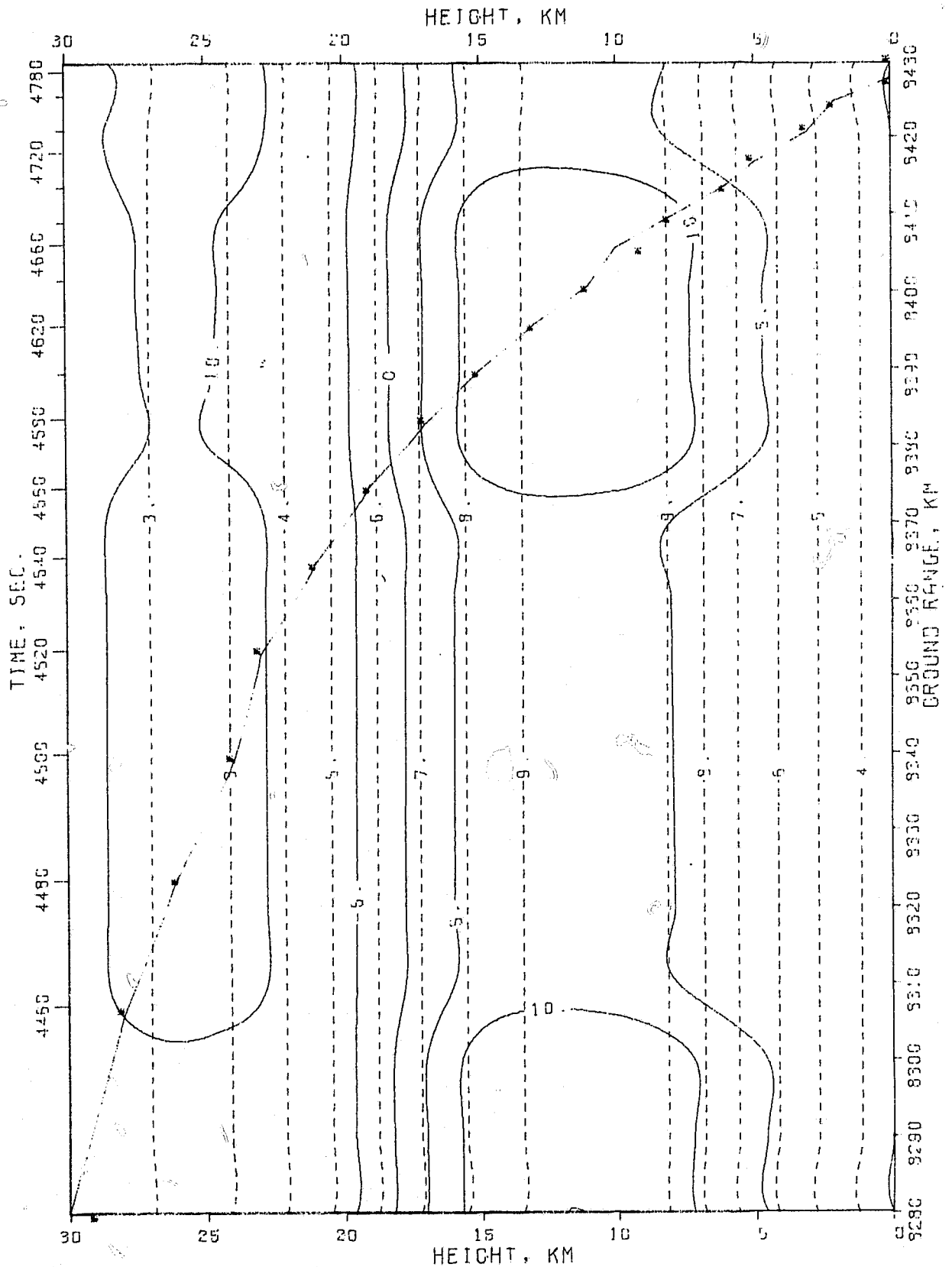
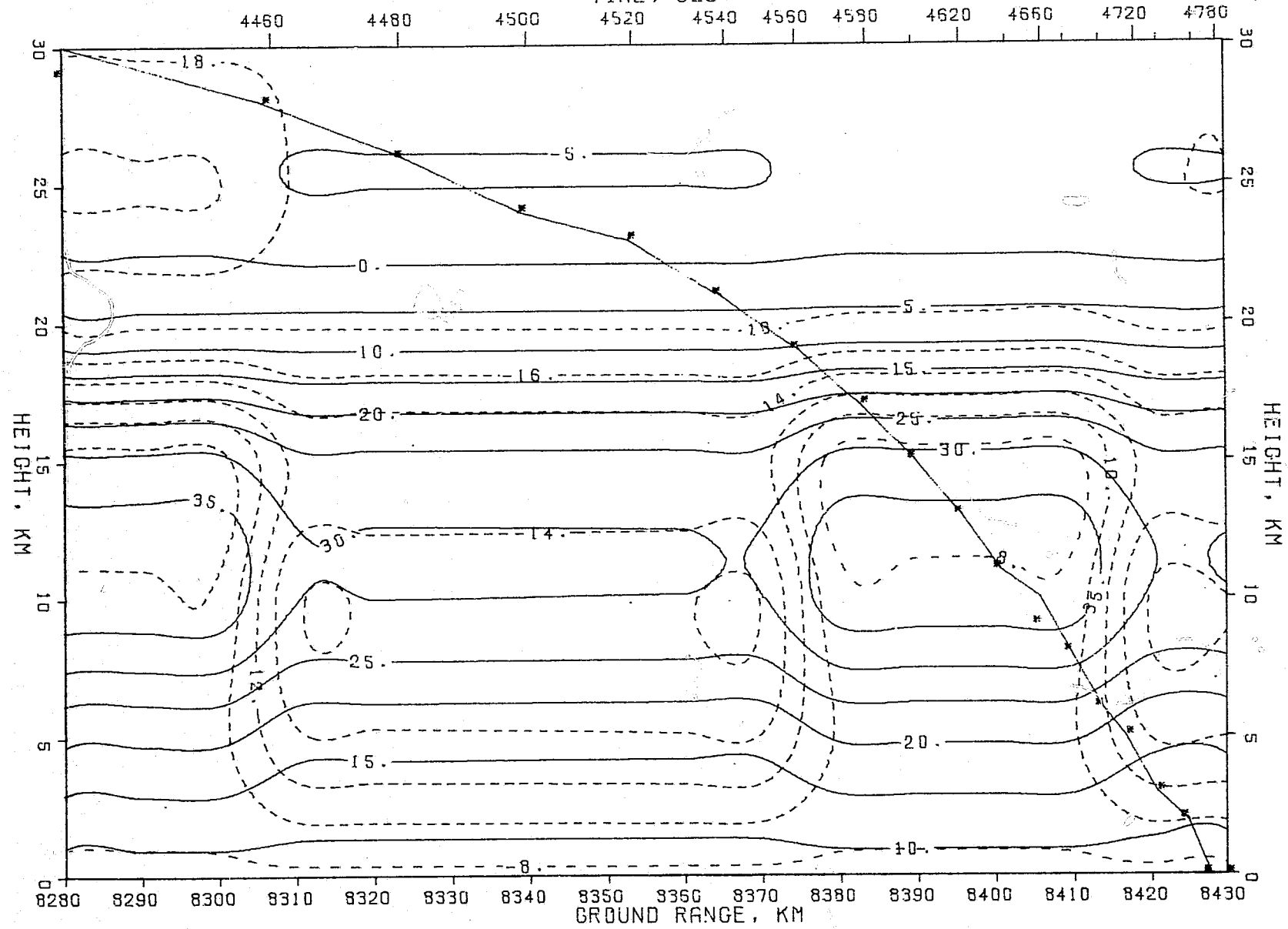


FIG 181

KEY
 --- EASTWARD WIND GEOSTROPHIC MONTHLY MEAN, M/S.
 --- STD. DEV. OF EASTWARD WIND
 * --- TRAJECTORY
 DURING MONTH OF JULY



TIME, SEC.



KEY

— UPPER 99TH PERCENTILE OF EASTWARD WIND

- - - LOWER 99TH PERCENTILE OF EASTWARD WIND

* - - - TRAJECTORY

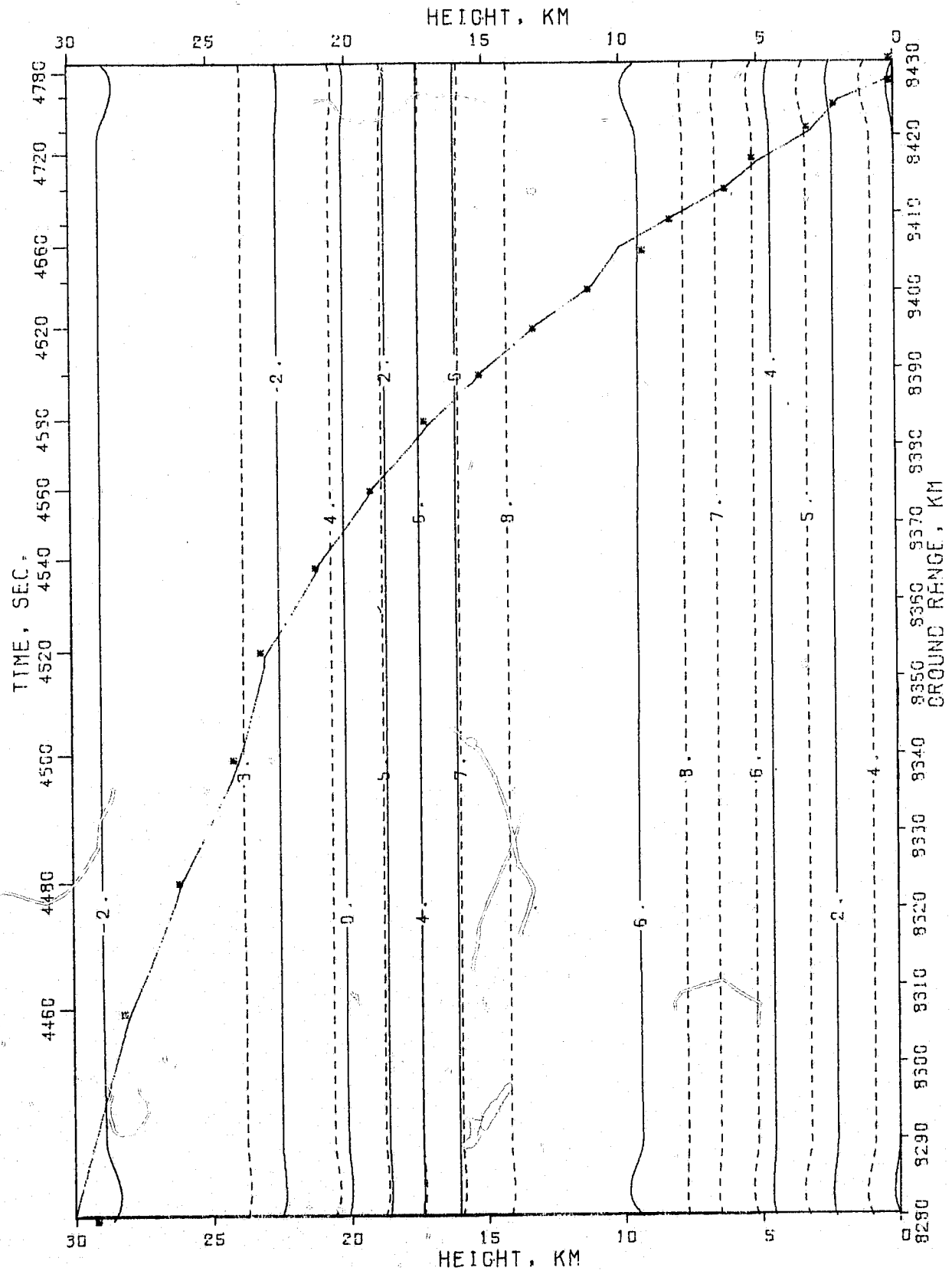
DURING MONTH OF JULY

FIG 182

FIG 1183

KEY

- NORTHWARD WIND GEOSTROPHIC MONTHLY MEAN, M/S.
- - - STD. DEV. OF NORTHWARD WIND
- — TRAJECTORY DURING MONTH OF JULY



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FIG 184

KEY

- UPPER 99TH PERCENTILE OF NORTHWARD WIND
- - - LOWER 99TH PERCENTILE OF NORTHWARD WIND
- * — TRAJECTORY DURING MONTH OF JULY

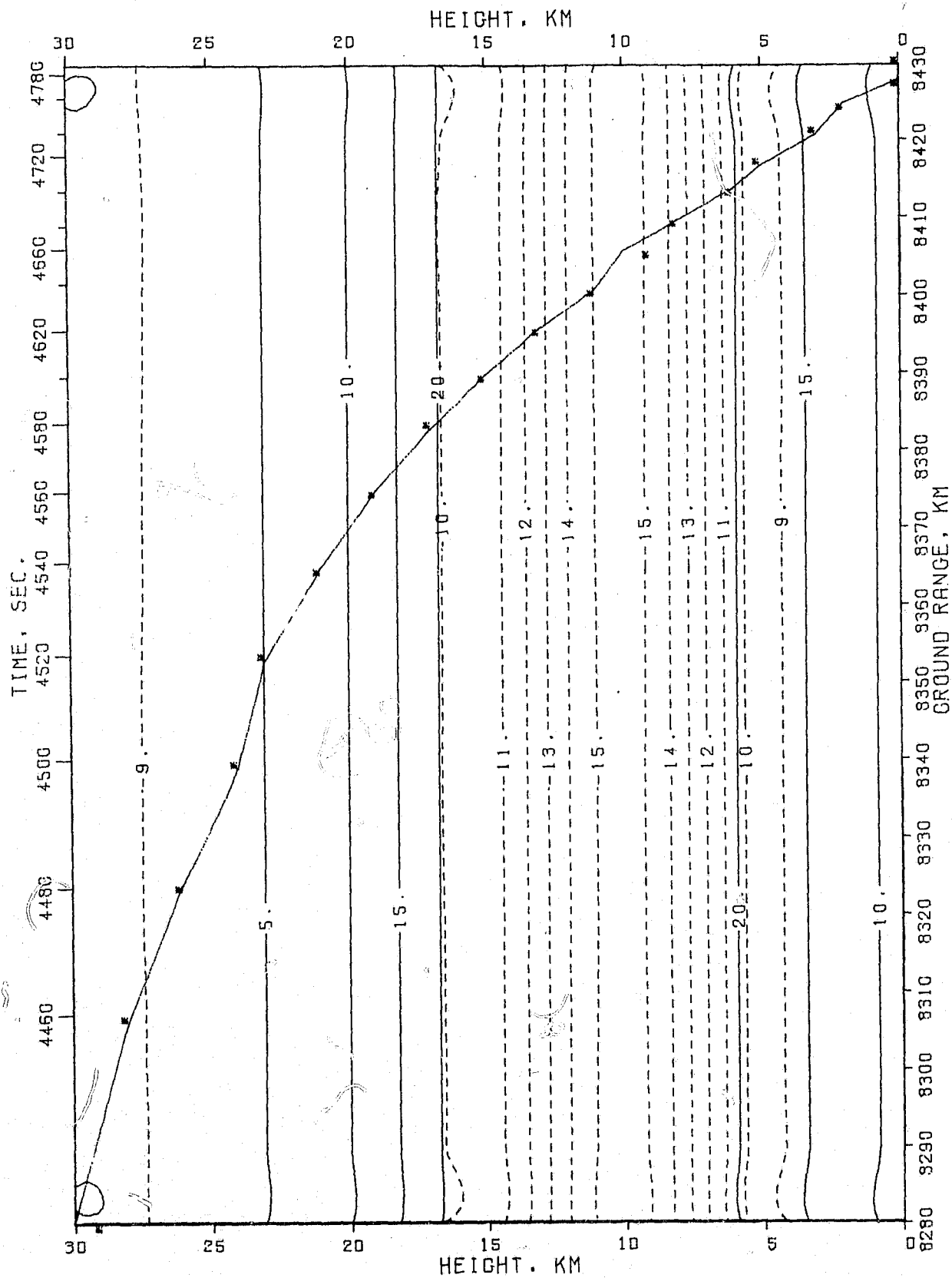
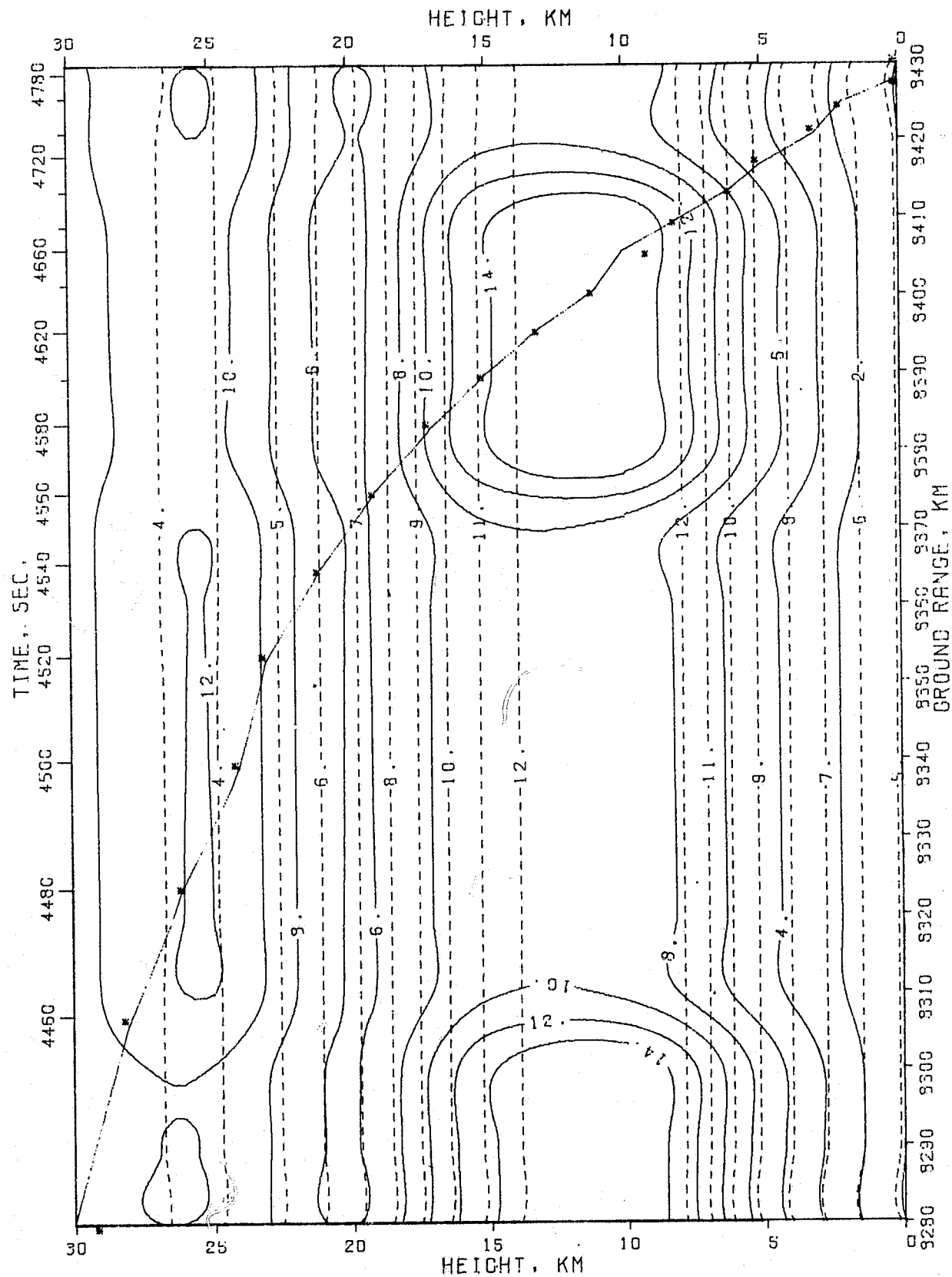


FIG 185

KEY

- WIND SPEED, M/S.
- - - STD. DEV. OF WIND SPEED
- * — * TRAJECTORY
- DURING MONTH OF JULY



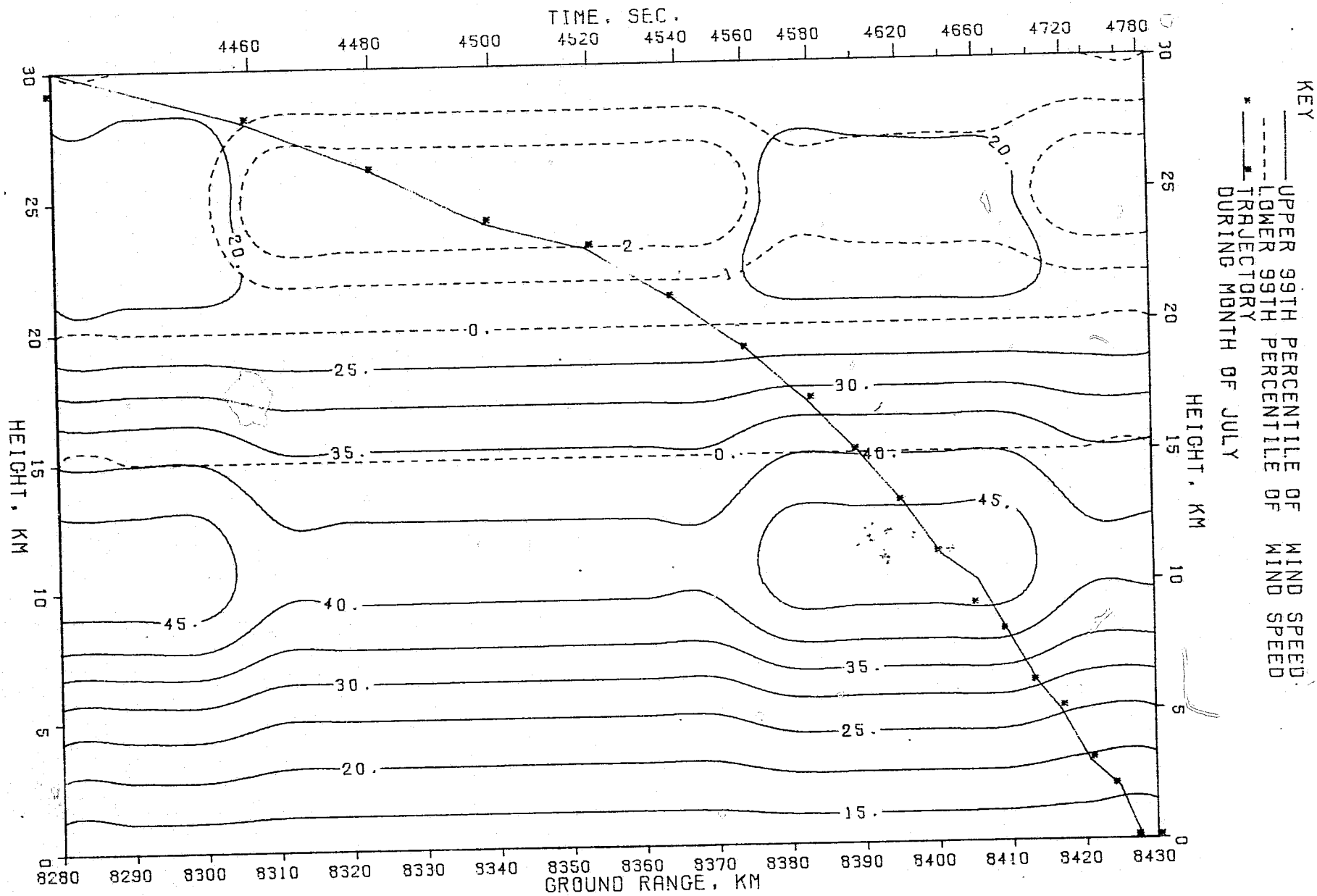
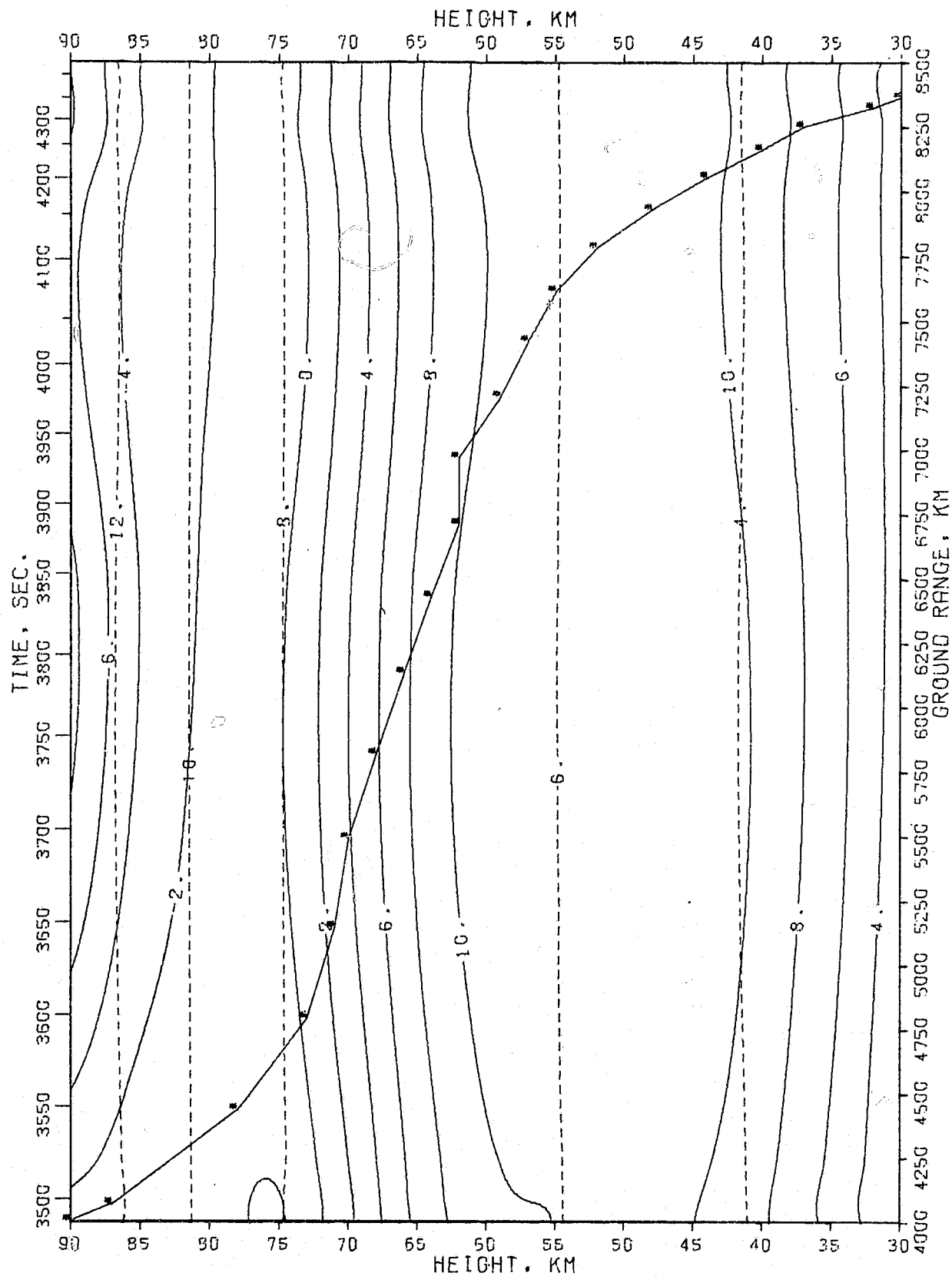


FIG 186

FIG 187

KEY

- PRESSURE. PERCENT DEV. FROM STD. ATM.
 - - - STD. DEV. OF PRESSURE
 —●— TRAJECTORY
 DURING MONTH OF JULY



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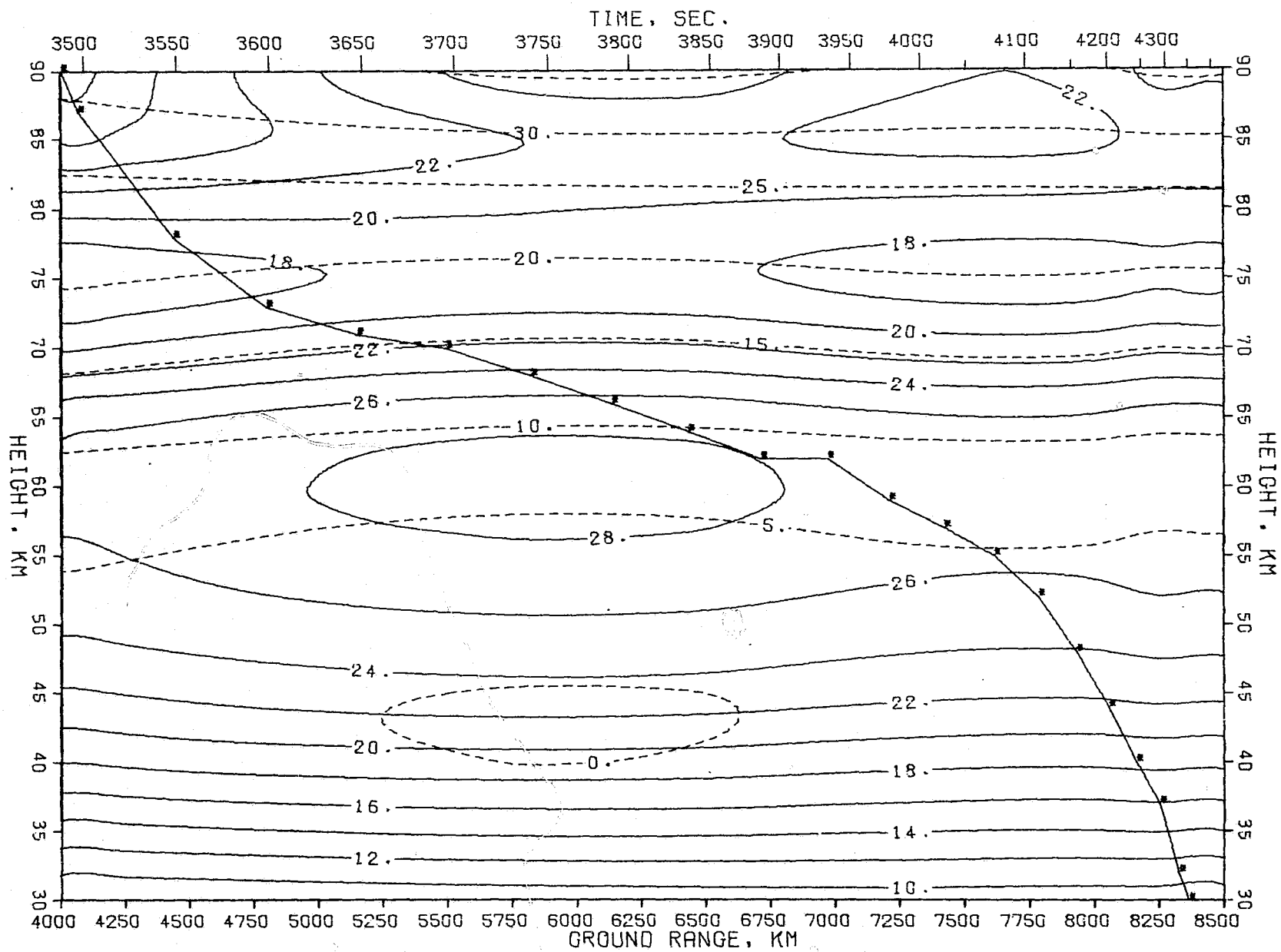
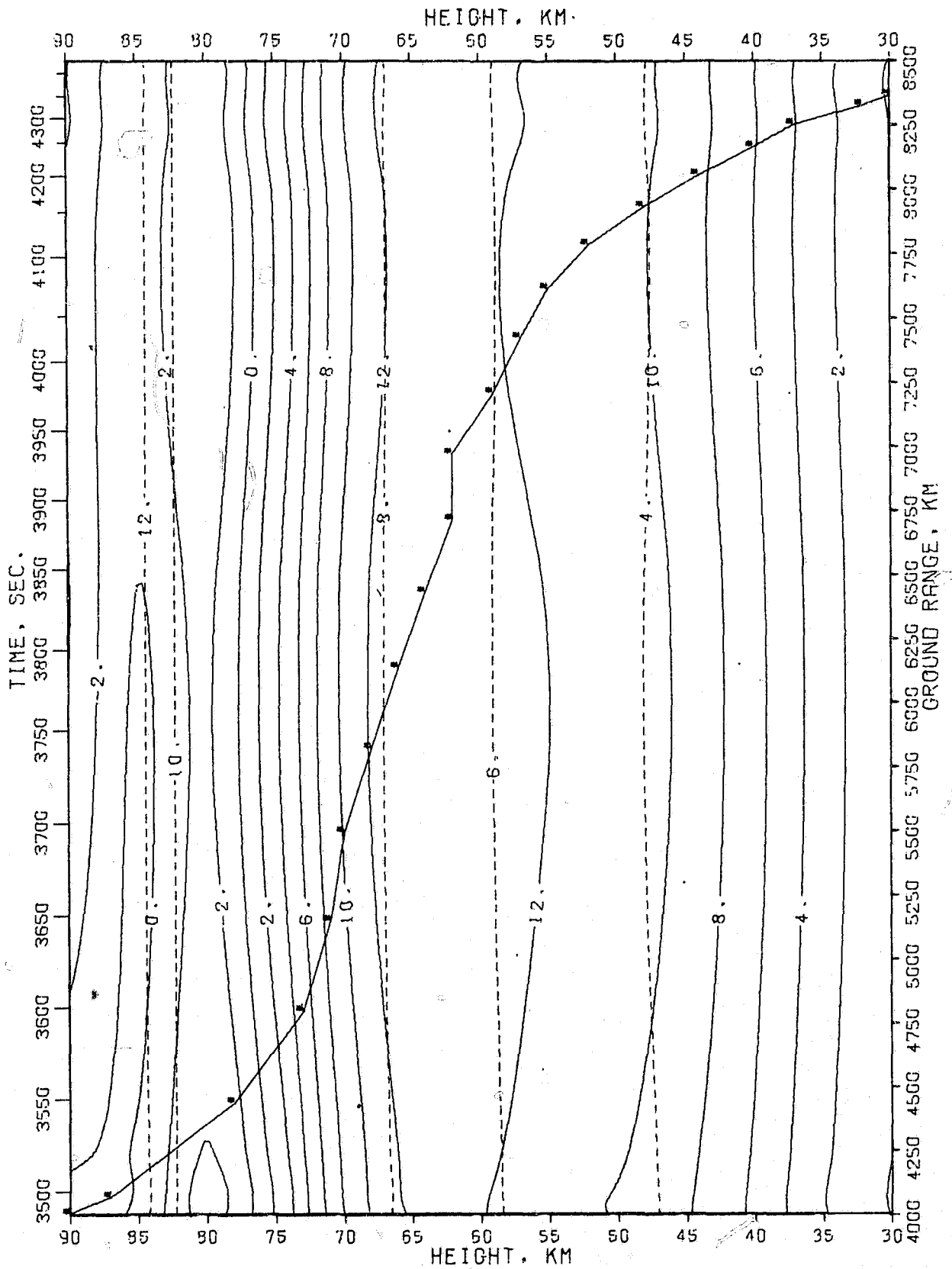


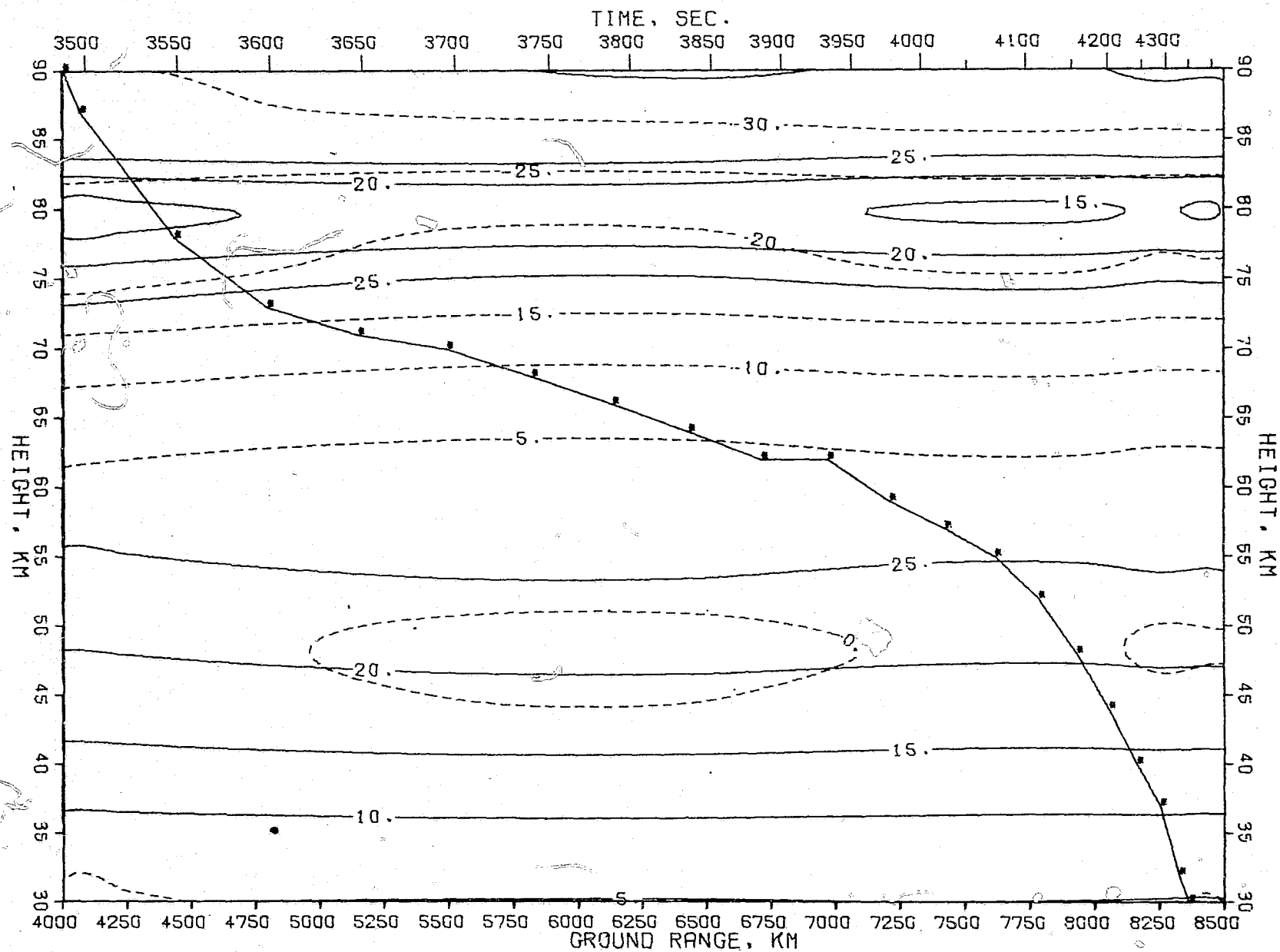
FIG 188

FIG 189

KEY

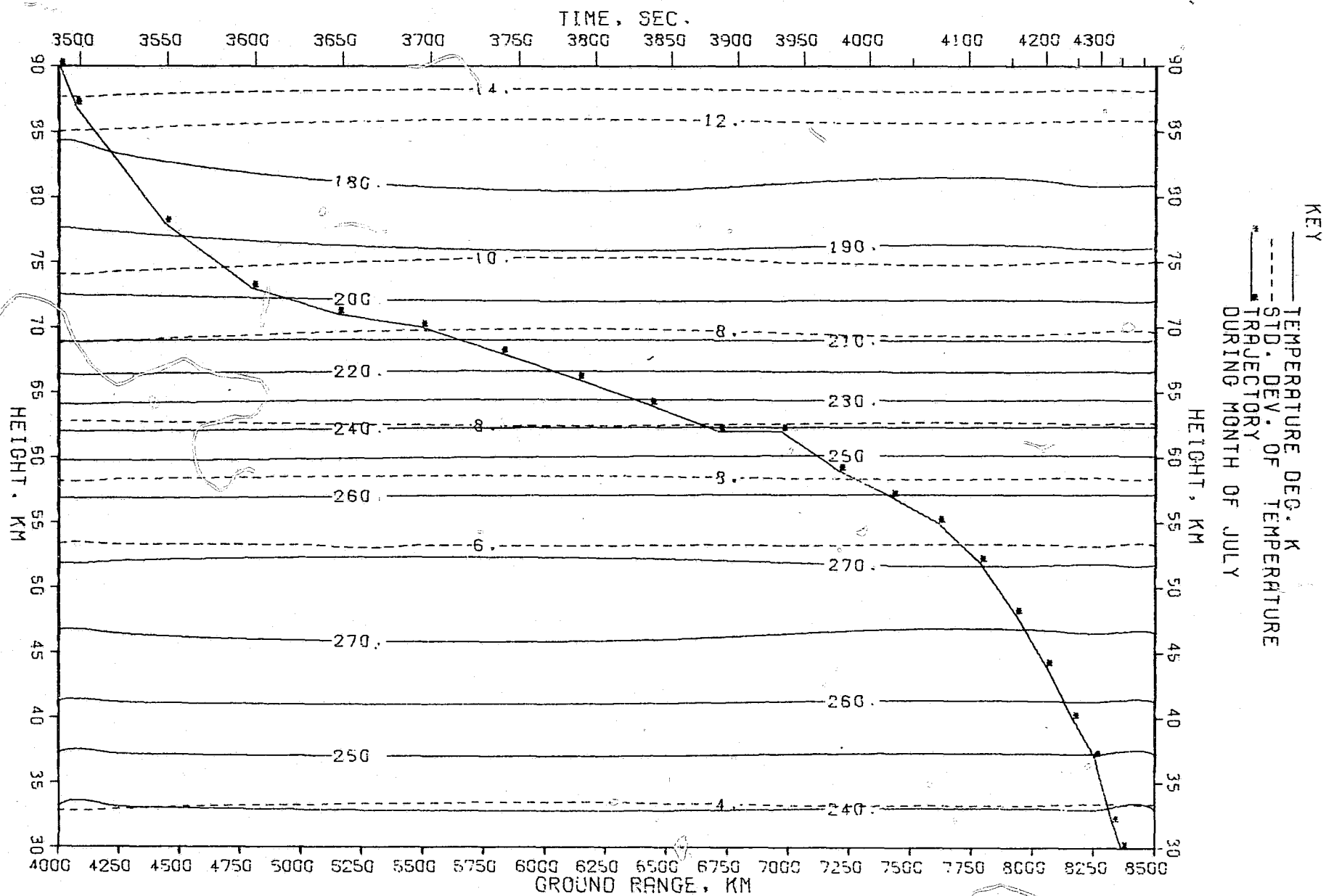
- DENSITY PERCENT DEV. FROM STD. ATM.
- - - STD. DEV. OF DENSITY
- ■ — TRAJECTORY
- DURING MONTH OF JULY





KEY
 — UPPER 99TH PERCENTILE OF DENSITY
 - - - LOWER 99TH PERCENTILE OF DENSITY
 — TRAJECTORY
 DURING MONTH OF JULY

FIG 190



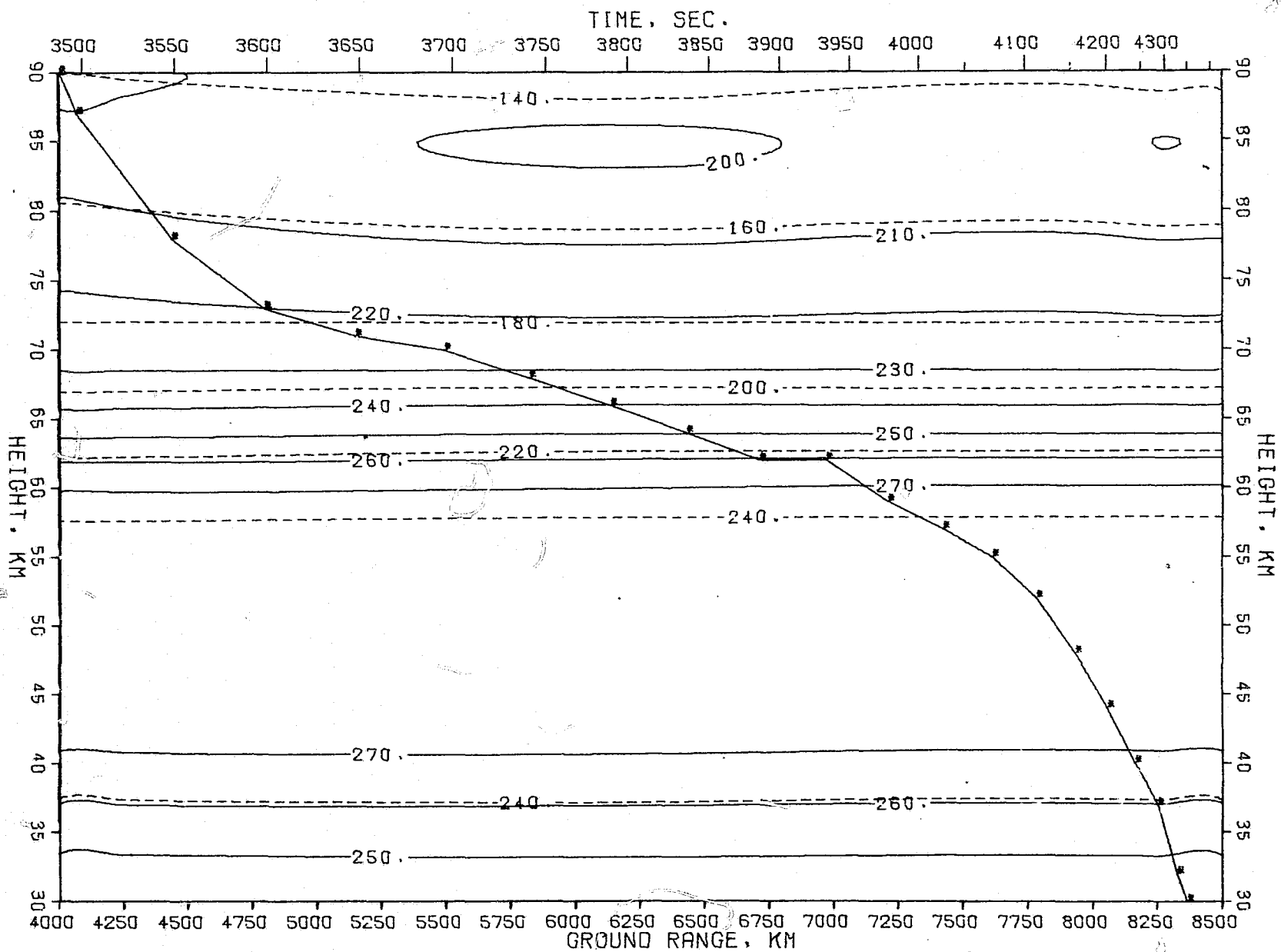
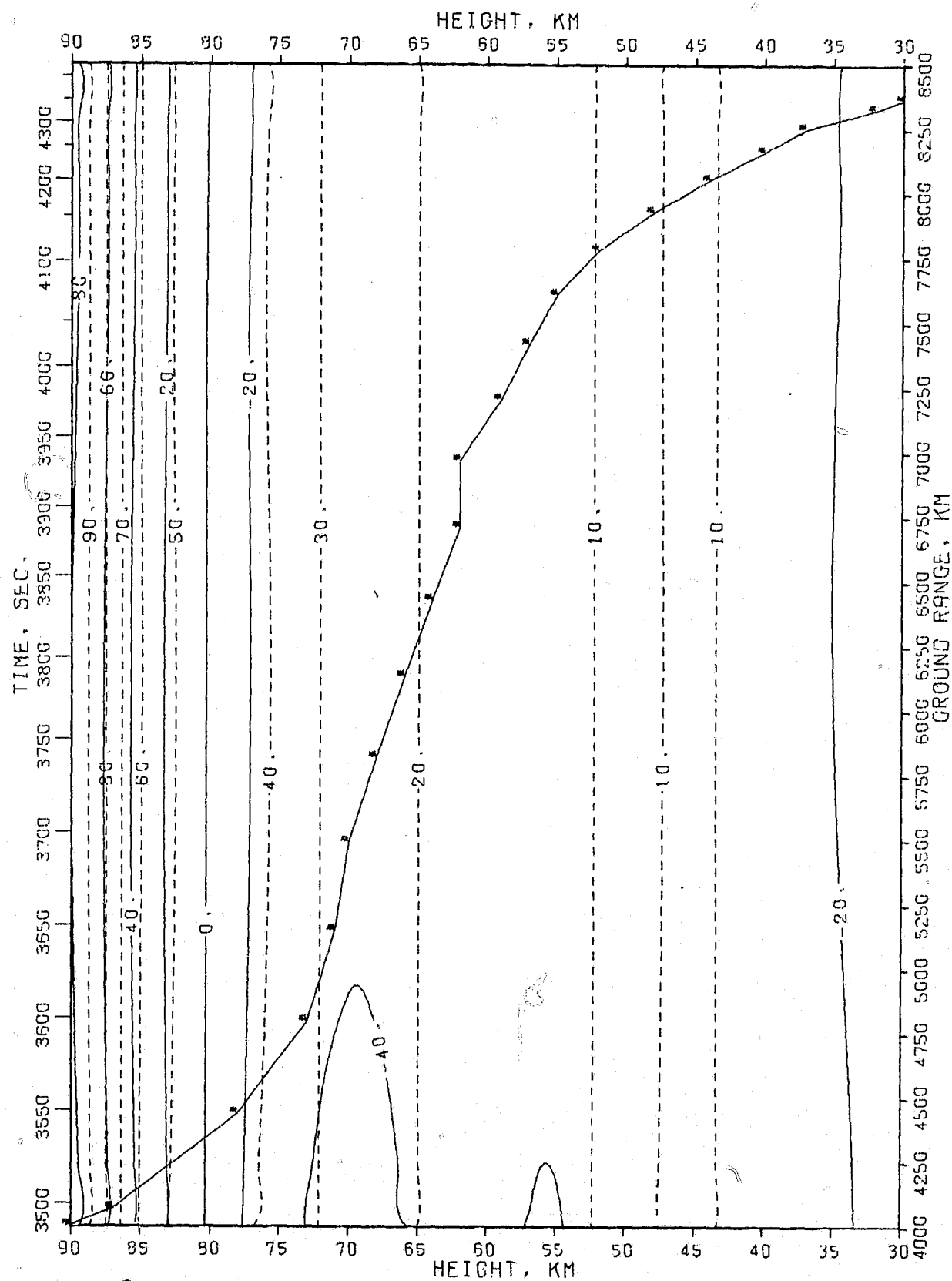


FIG 193

KEY

- EASTWARD WIND GEOSTROPHIC MONTHLY MEAN, M/S.
- - - STD. DEV. OF EASTWARD WIN
- TRAJECTORY
- DURING MONTH OF JULY



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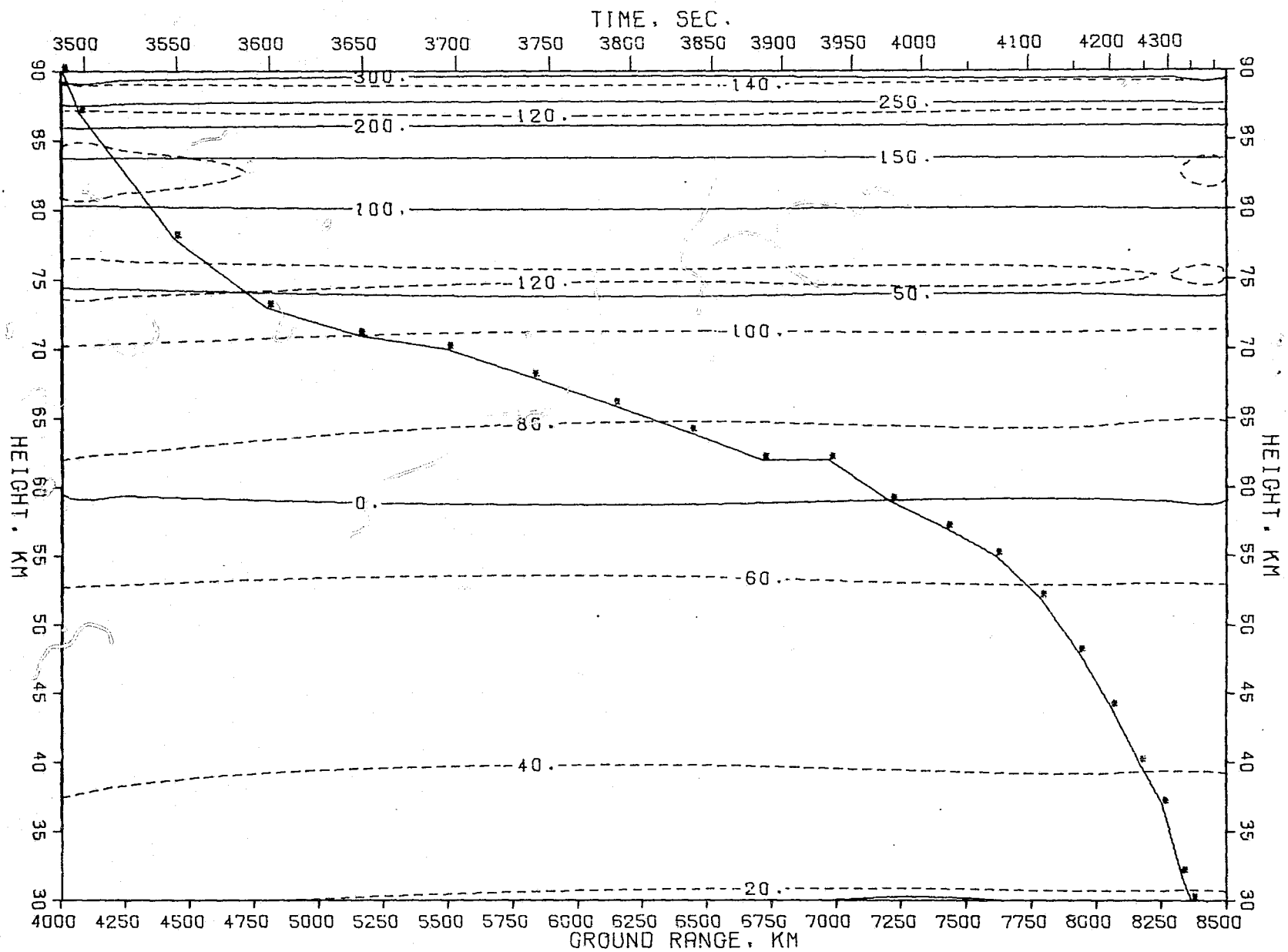
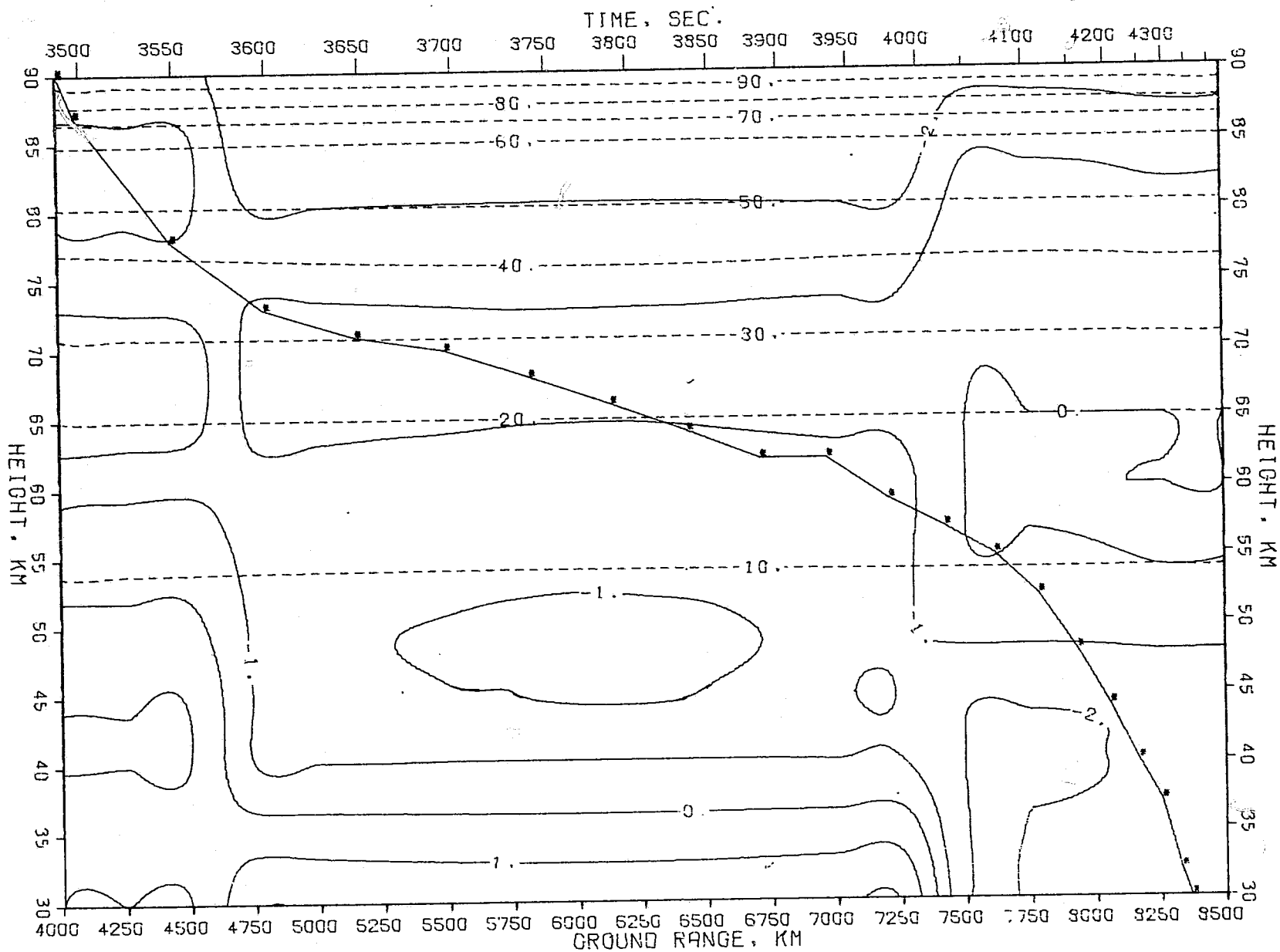
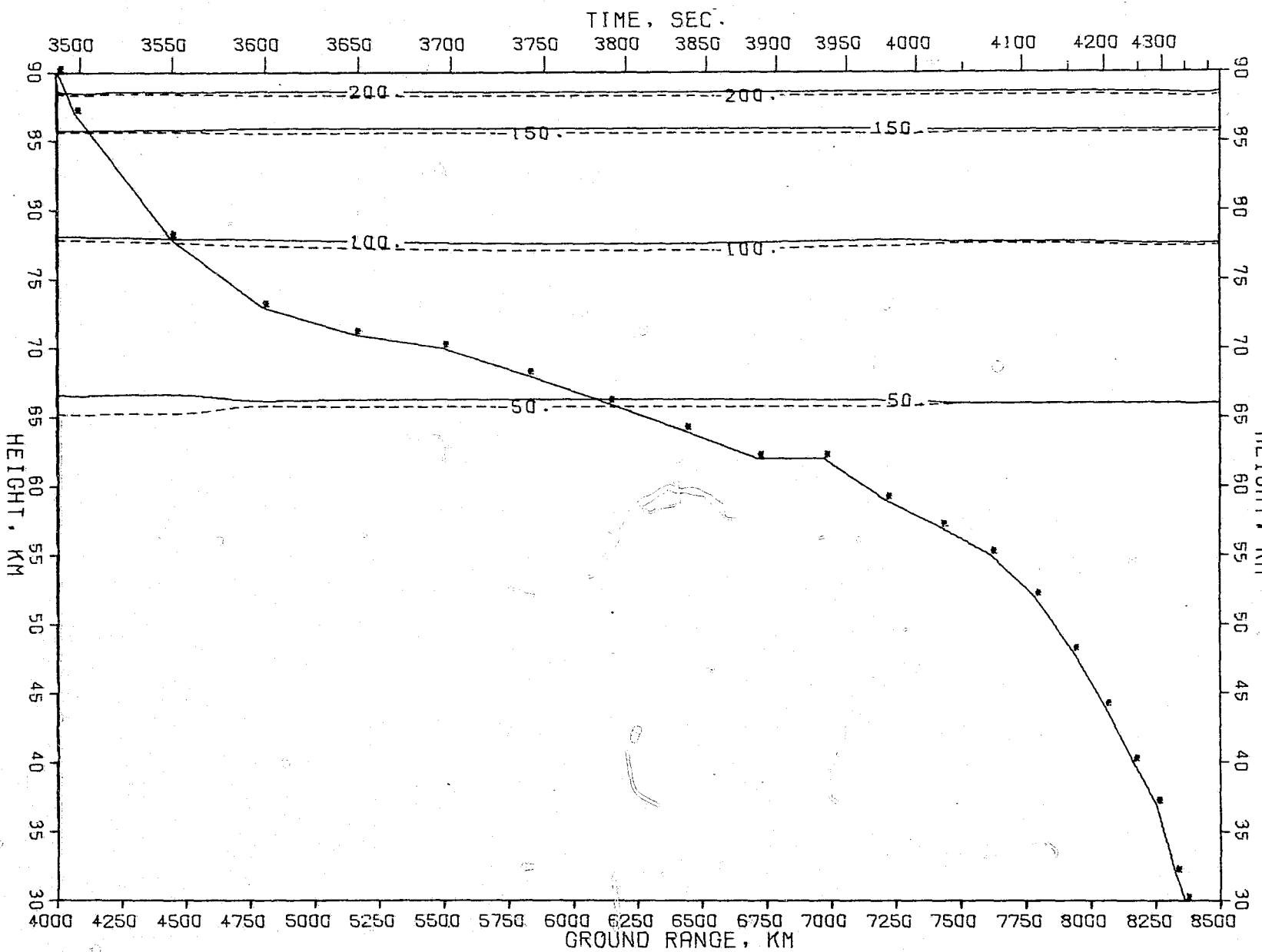


FIG 194

FIG 195

KEY
 — NORTHWARD WIND GEOSTROPHIC MONTHLY MEAN, M/S.
 - - - STD. DEV. OF NORTHWARD WIND
 — TRAJECTORY
 ■ DURING MONTH OF JULY





KEY

— UPPER 99TH PERCENTILE OF NORTHWARD WIND TRAJECTORY

--- LOWER 99TH PERCENTILE OF NORTHWARD WIND TRAJECTORY

— DURING MONTH OF JULY

FIG 196

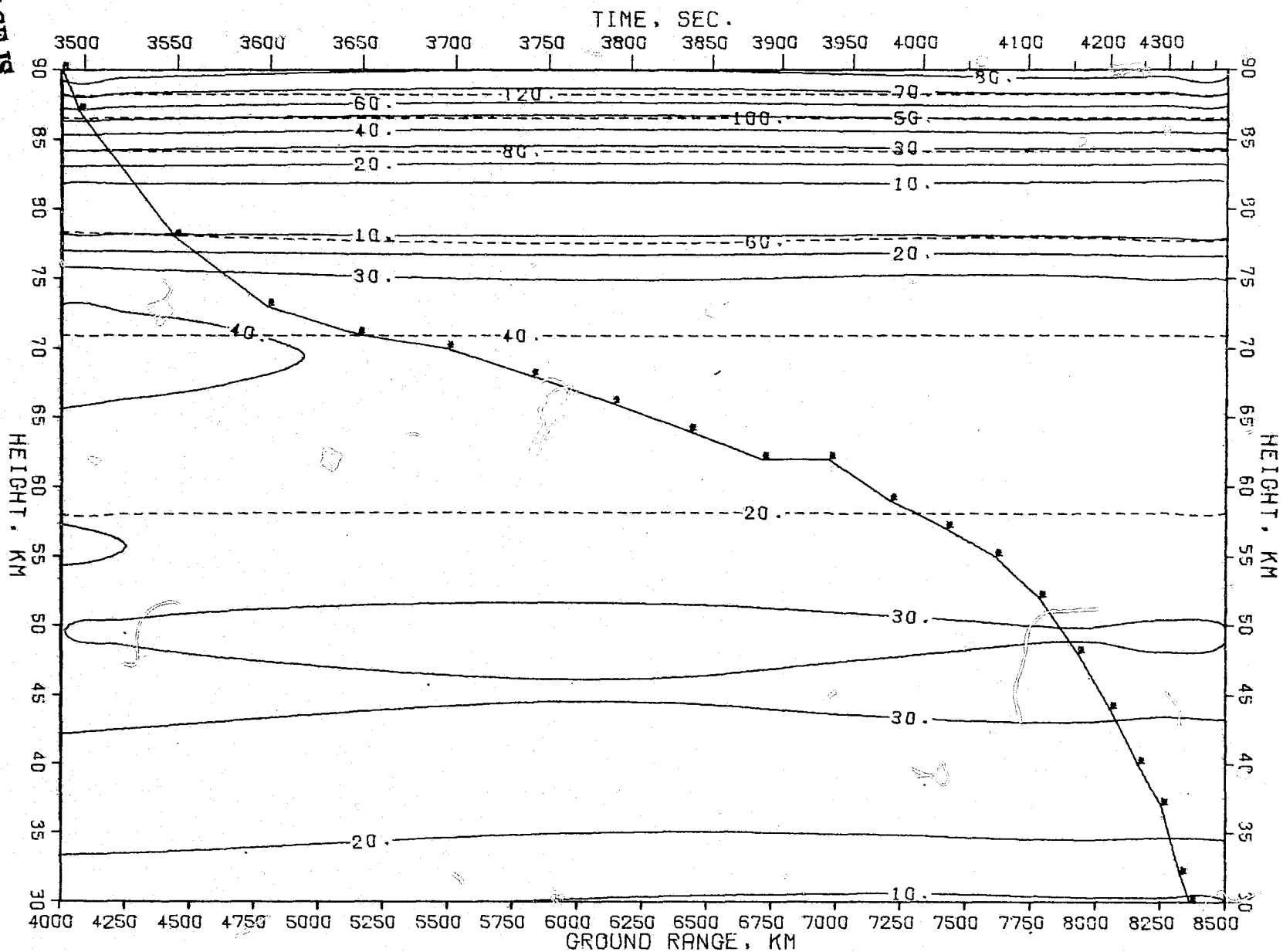


FIG 197

TIME, SEC.

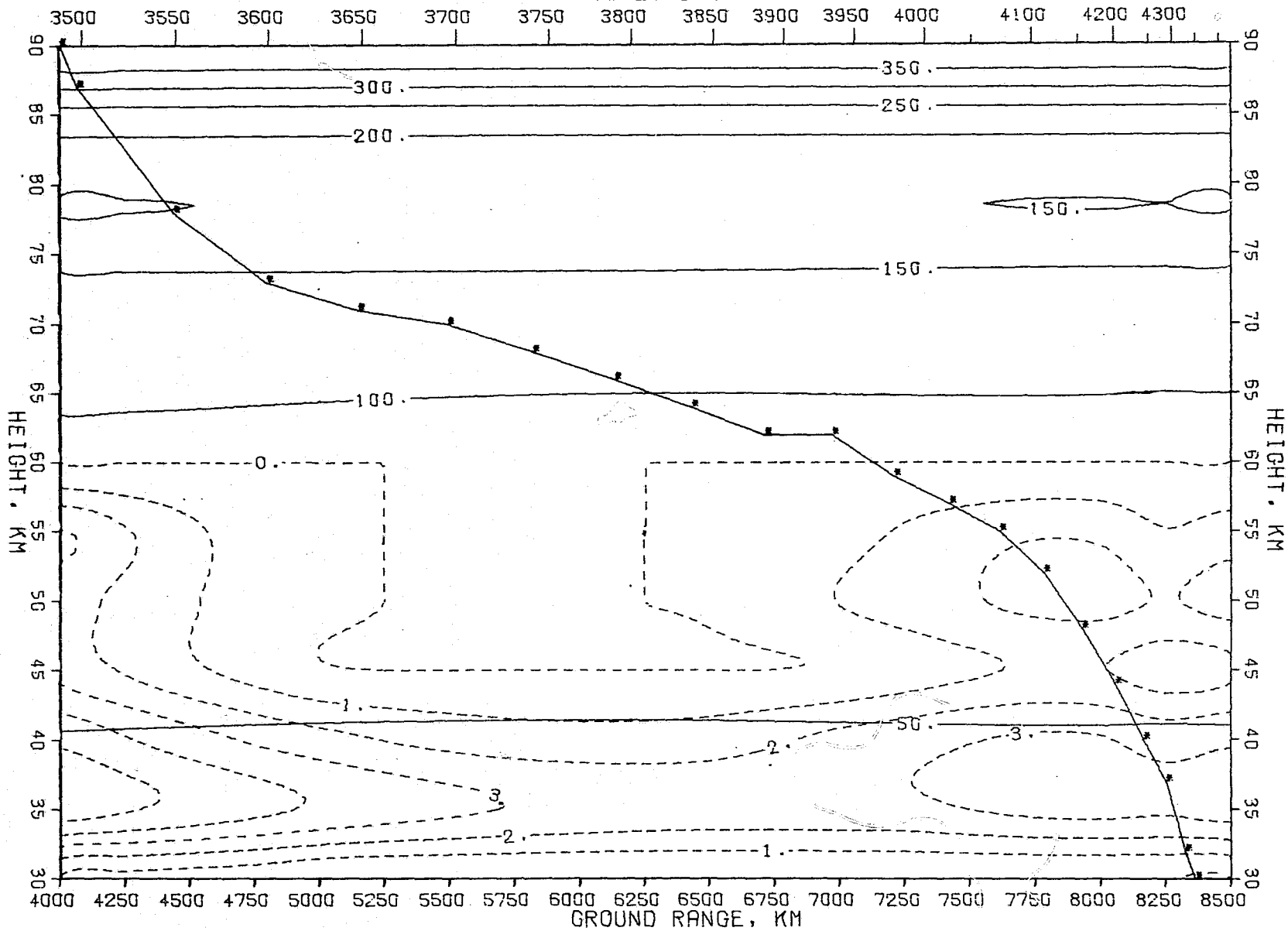
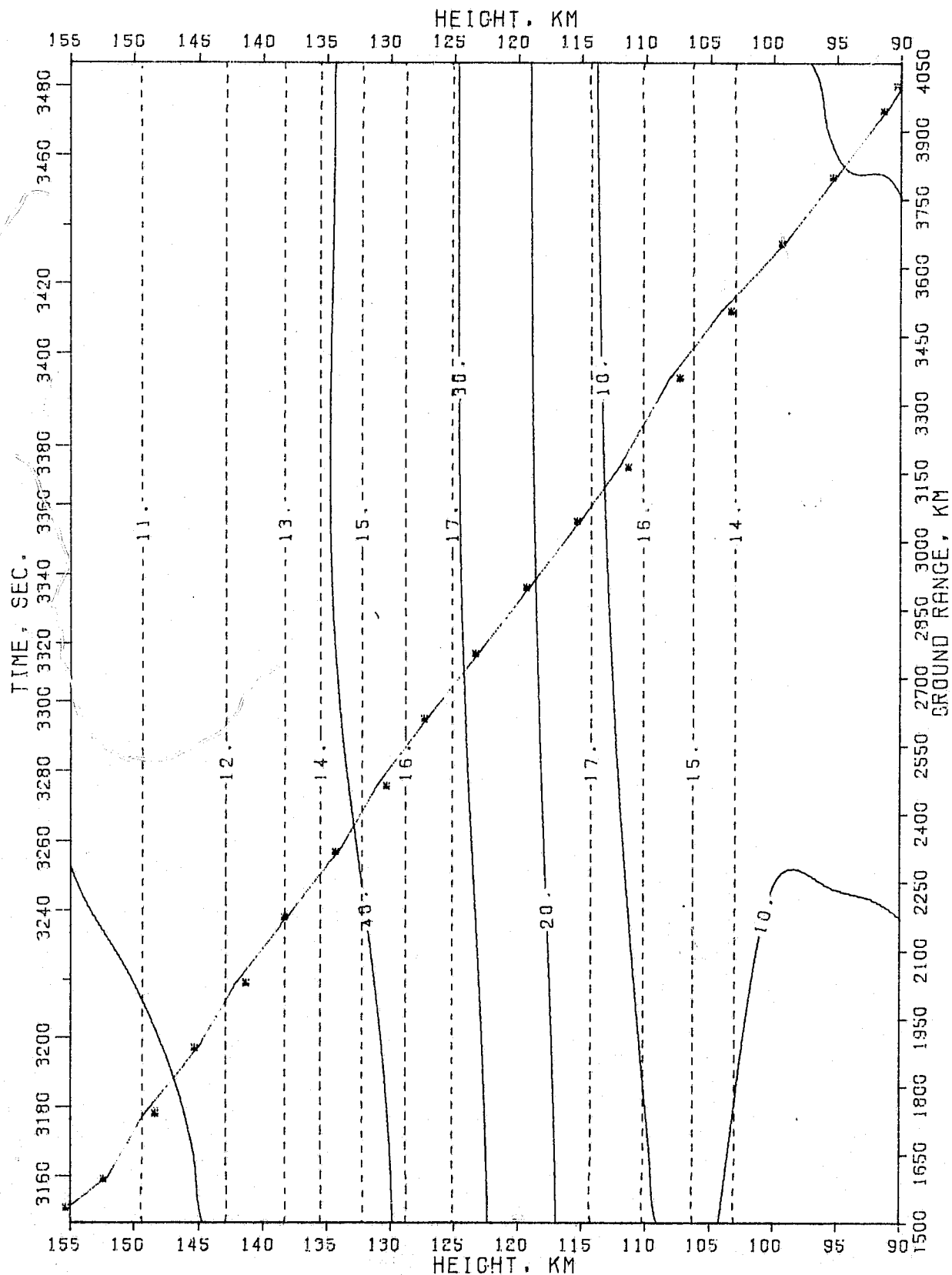


FIG 198

FIG 199

KEY

- PRESSURE. PERCENT DEV. FROM STD. ATM.
 - - - - - STD. DEV. OF PRESSURE
 * - - - - TRAJECTORY
 DURING MONTH OF JULY WITH HIGH SOLAR ACTIVITY



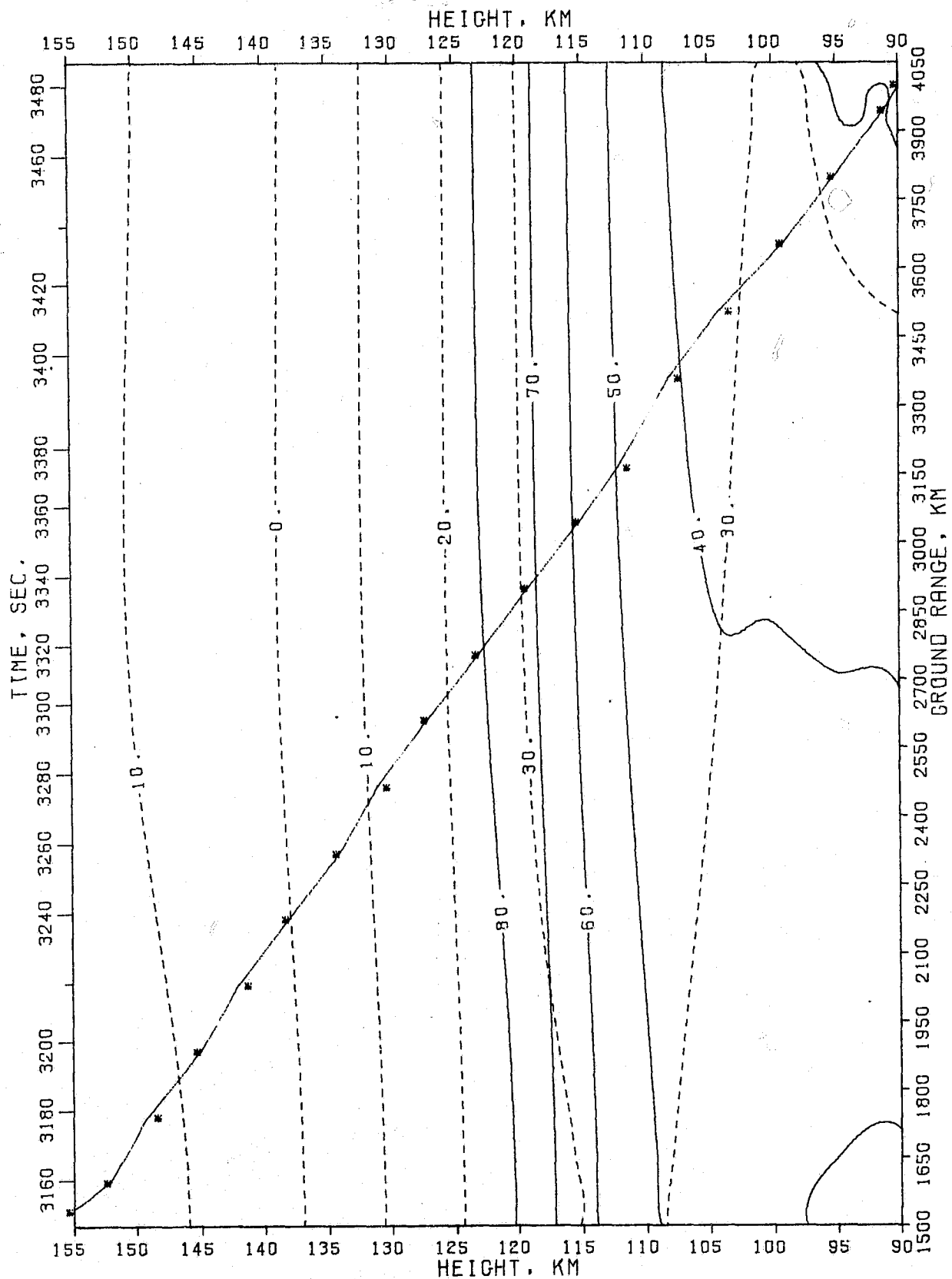
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FIG 200

KEY

— UPPER 99TH PERCENTILE OF PRESSURE
 - - - LOWER 99TH PERCENTILE OF PRESSURE
 * — TRAJECTORY

DURING MONTH OF JULY WITH HIGH SOLAR ACTIVITY



KEY

- DENSITY PERCENT DEV. FROM STD. ATM.
- STD. DEV. OF DENSITY
- *---* TRAJECTORY
- DURING MONTH OF JULY WITH HIGH SOLAR ACTIVITY

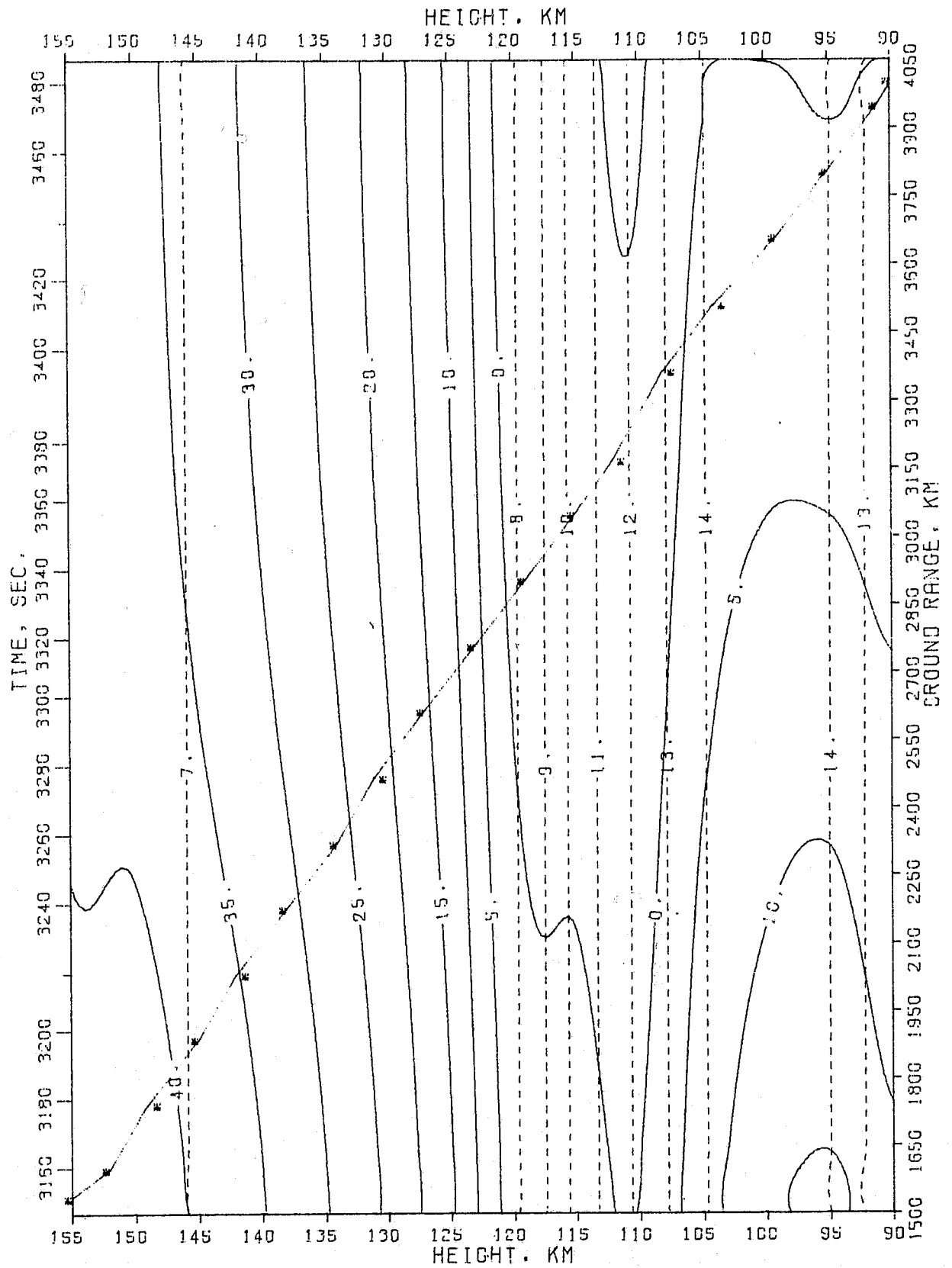


FIG 202

KEY

- UPPER 99TH PERCENTILE OF DENSITY
 - - - LOWER 99TH PERCENTILE OF DENSITY
 * — TRAJECTORY
 DURING MONTH OF JULY WITH HIGH SOLAR ACTIVITY

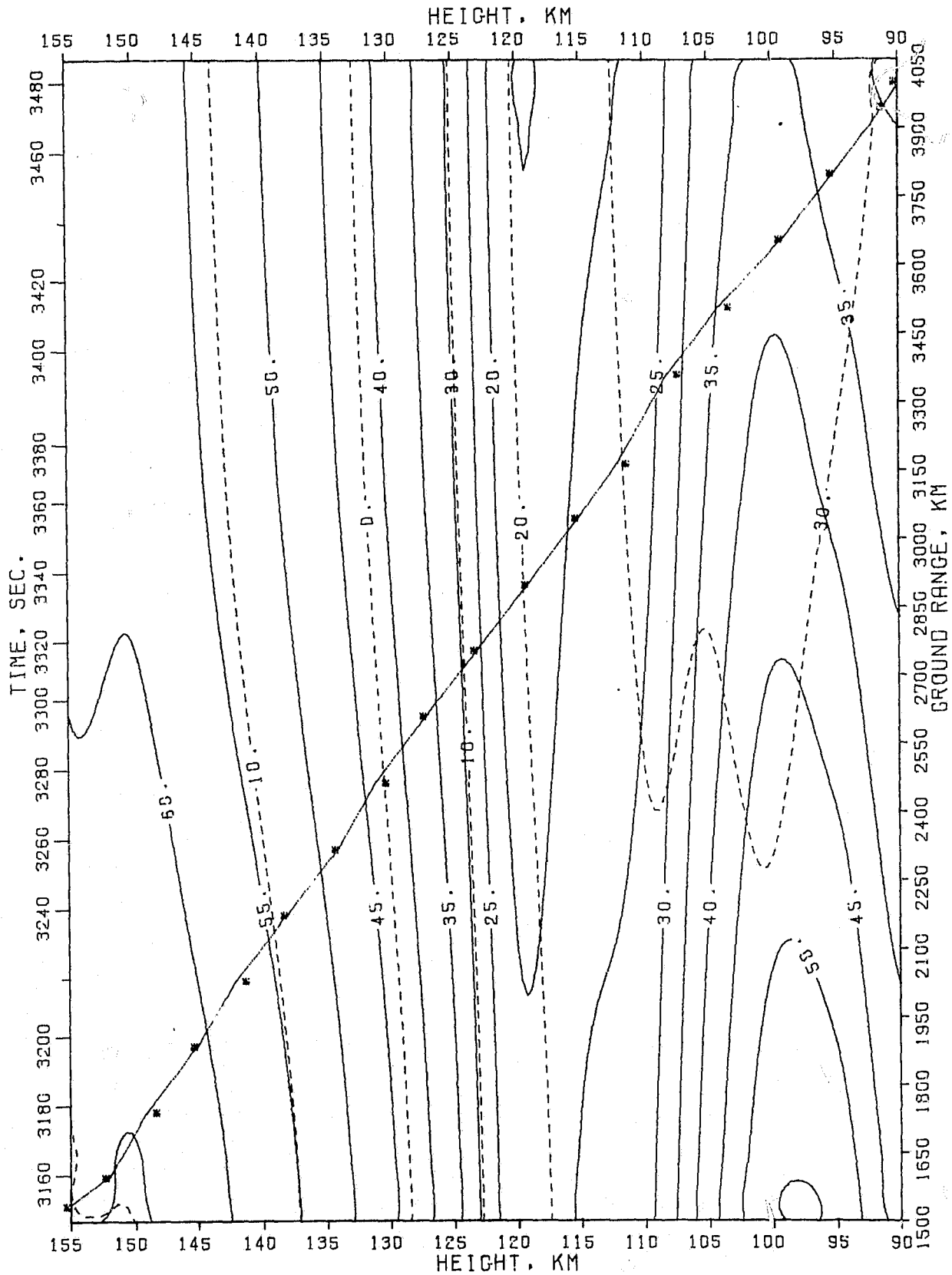
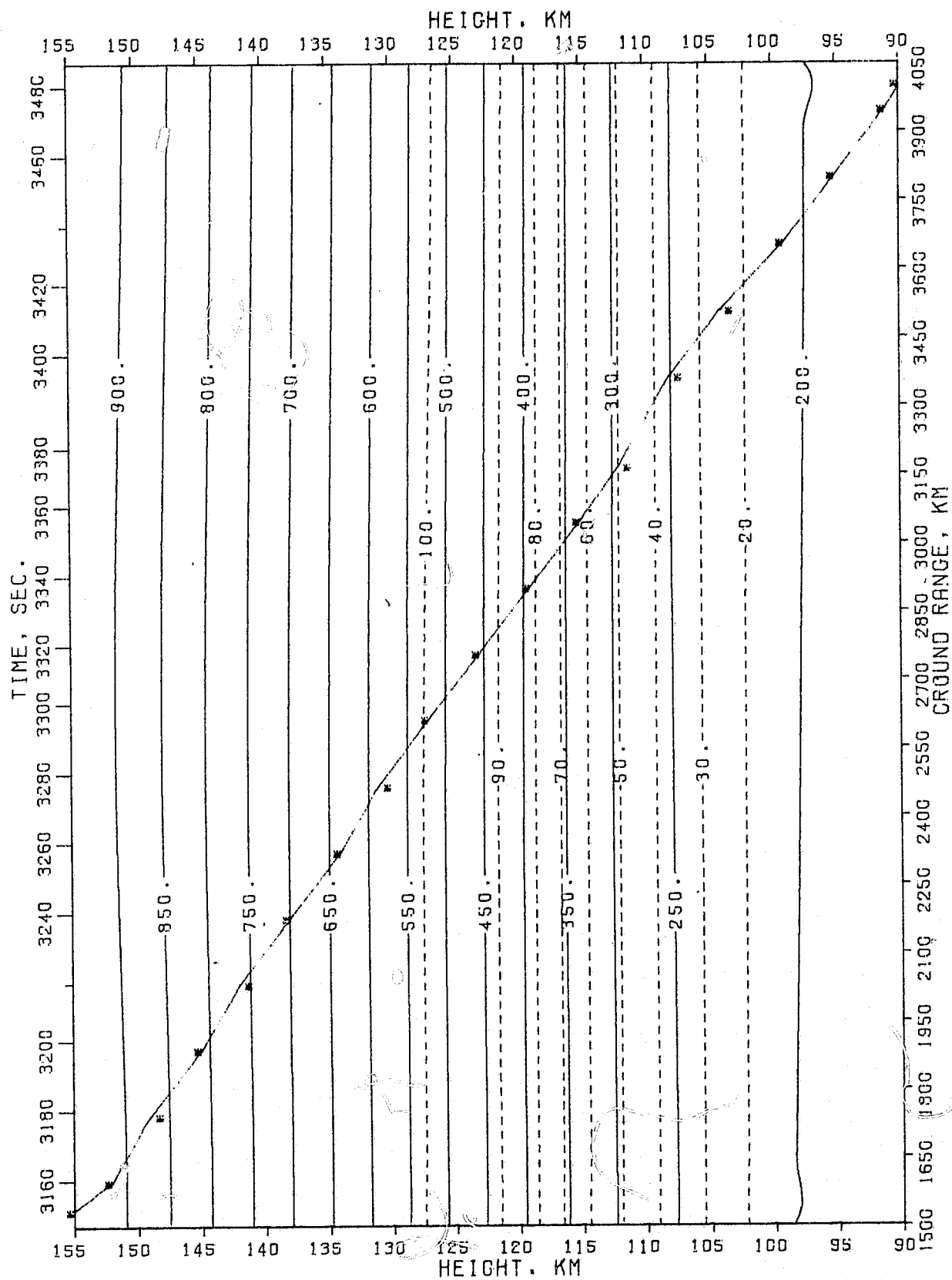


FIG 203

KEY

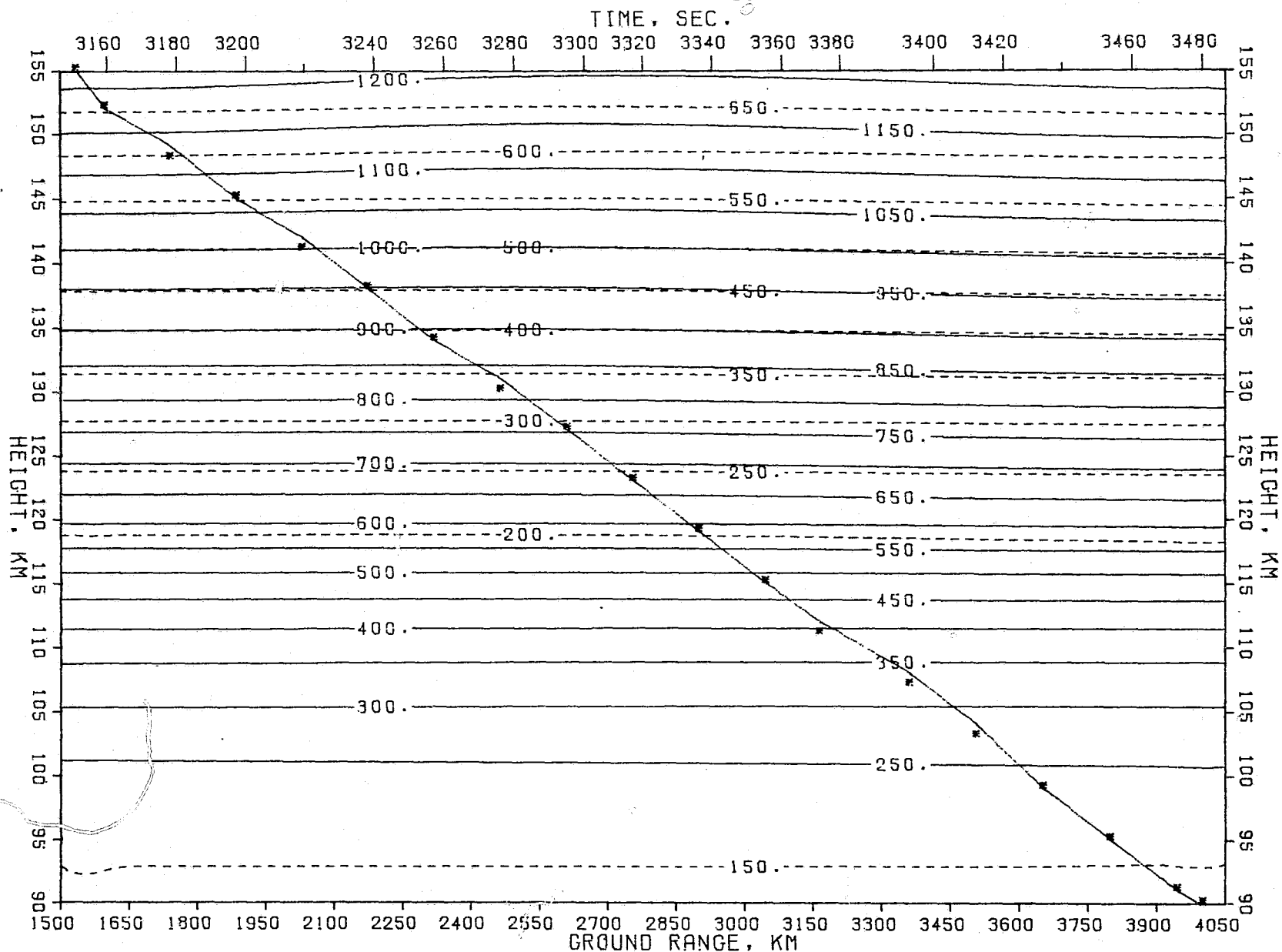
- TEMPERATURE DEG. K
 - - - - - STD. DEV. OF TEMPERATURE
 * ——— TRAJECTORY
 DURING MONTH OF JULY WITH HIGH SOLAR ACTIVITY



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FIG 204

KEY
 ——— UPPER 99TH PERCENTILE OF TEMPERATURE
 - - - - LOWER 99TH PERCENTILE OF TEMPERATURE
 * ——— TRAJECTORY
 DURING MONTH OF JULY WITH HIGH SOLAR ACTIVITY



KEY

— PRESSURE. PERCENT DEV. FROM STD. ATM.

- - - STD. DEV. OF PRESSURE

* — TRAJECTORY

DURING MONTH OF JULY WITH AVERAGE SOLAR ACTIVITY

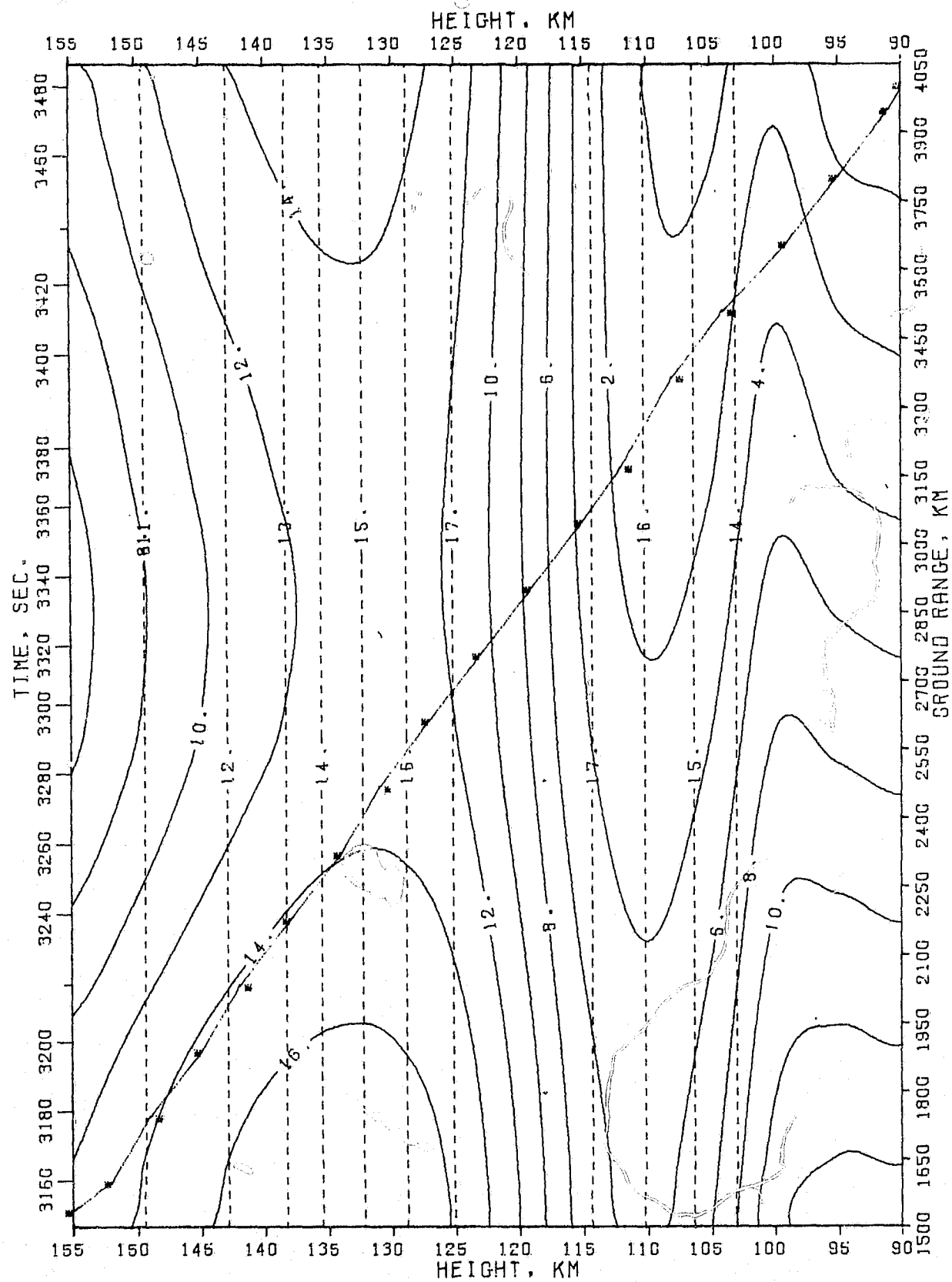
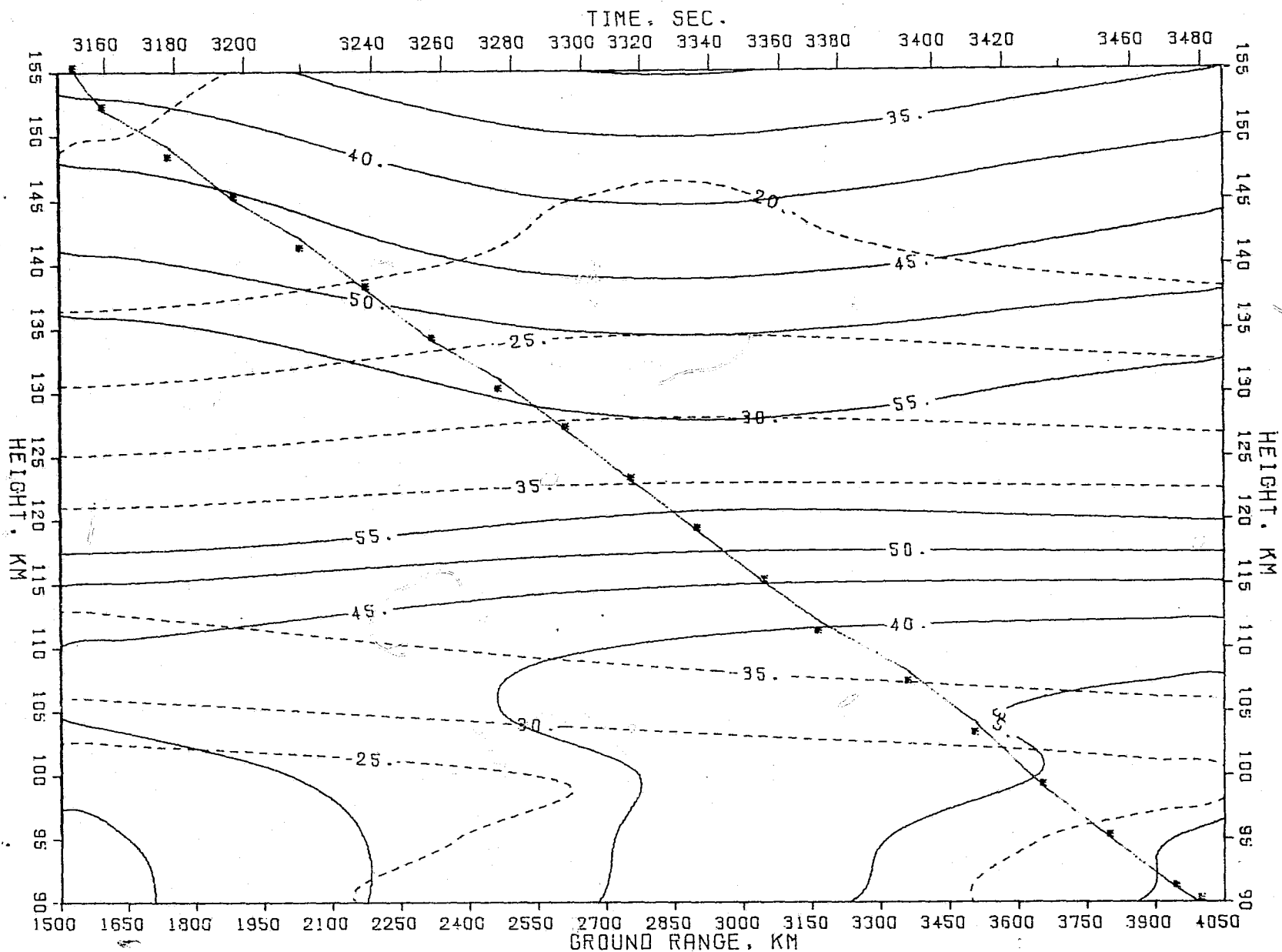


FIG 206

KEY
 — UPPER 99TH PERCENTILE OF PRESSURE
 - - - LOWER 99TH PERCENTILE OF PRESSURE
 * TRAJECTORY
 DURING MONTH OF JULY WITH AVERAGE SOLAR ACTIVITY



KEY

- DENSITY PERCENT DEV. FROM STD. ATM.
 - - - STD. DEV. OF DENSITY
 * — TRAJECTORY
 DURING MONTH OF JULY WITH AVERAGE SOLAR ACTIVITY

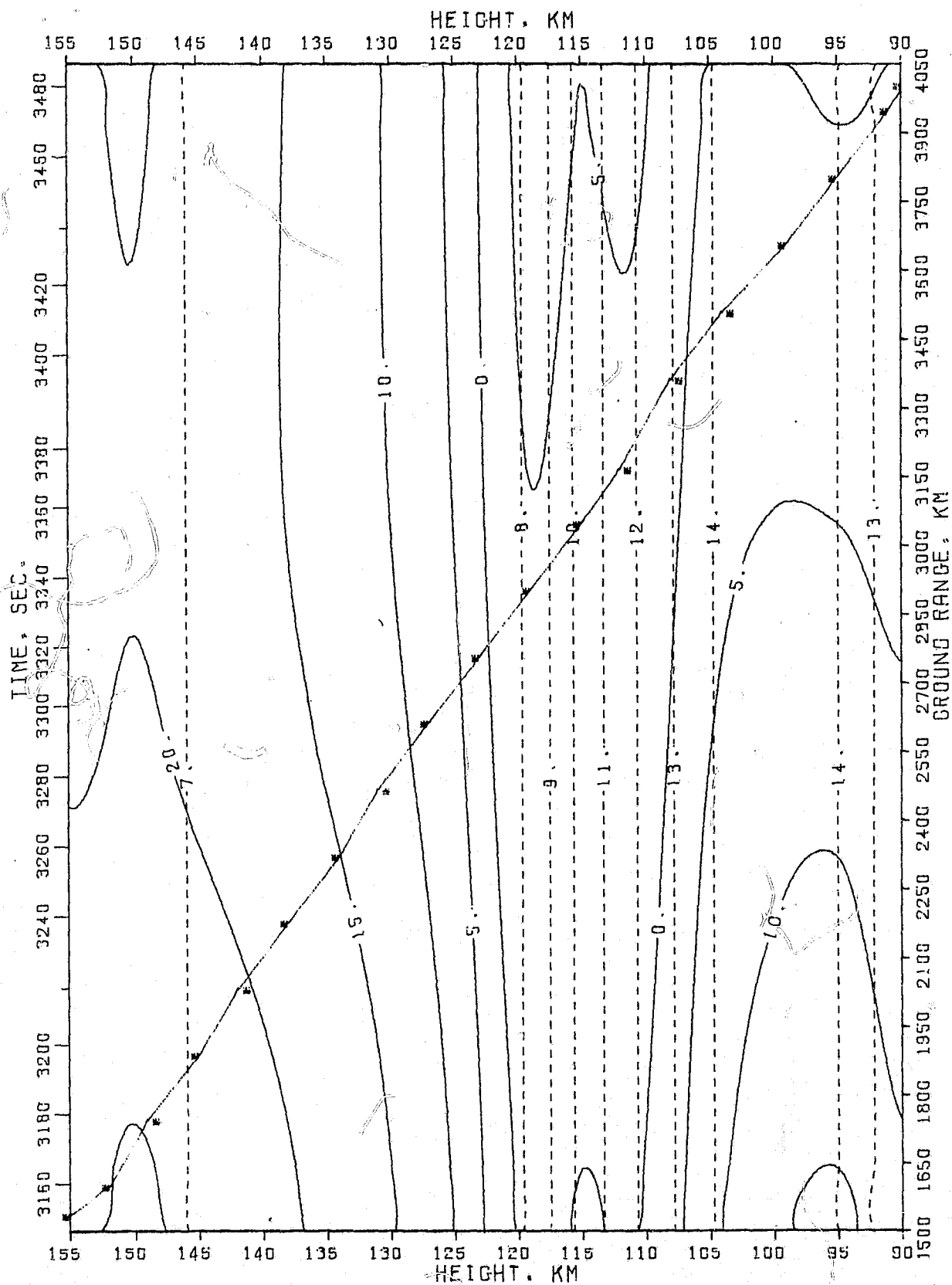


FIG 208

KEY

— UPPER 99TH PERCENTILE OF DENSITY
 --- LOWER 99TH PERCENTILE OF DENSITY
 * TRAJECTORY
 DURING MONTH OF JULY WITH AVERAGE SOLAR ACTIVITY

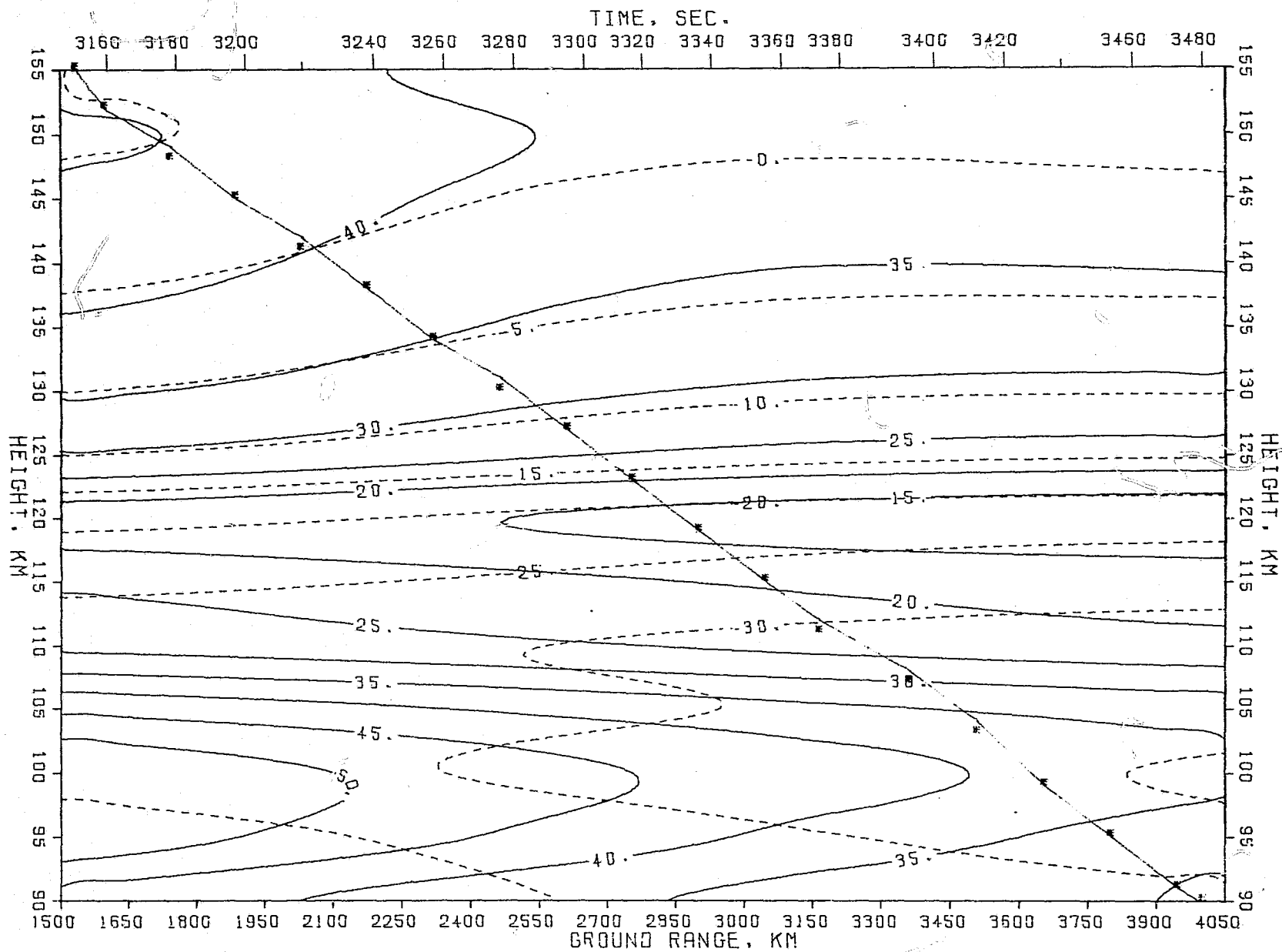


FIG 209

KEY

- TEMPERATURE DEG. K
 - - - STD. DEV. OF TEMPERATURE
 * — TRAJECTORY
 DURING MONTH OF JULY WITH AVERAGE SOLAR ACTIVITY

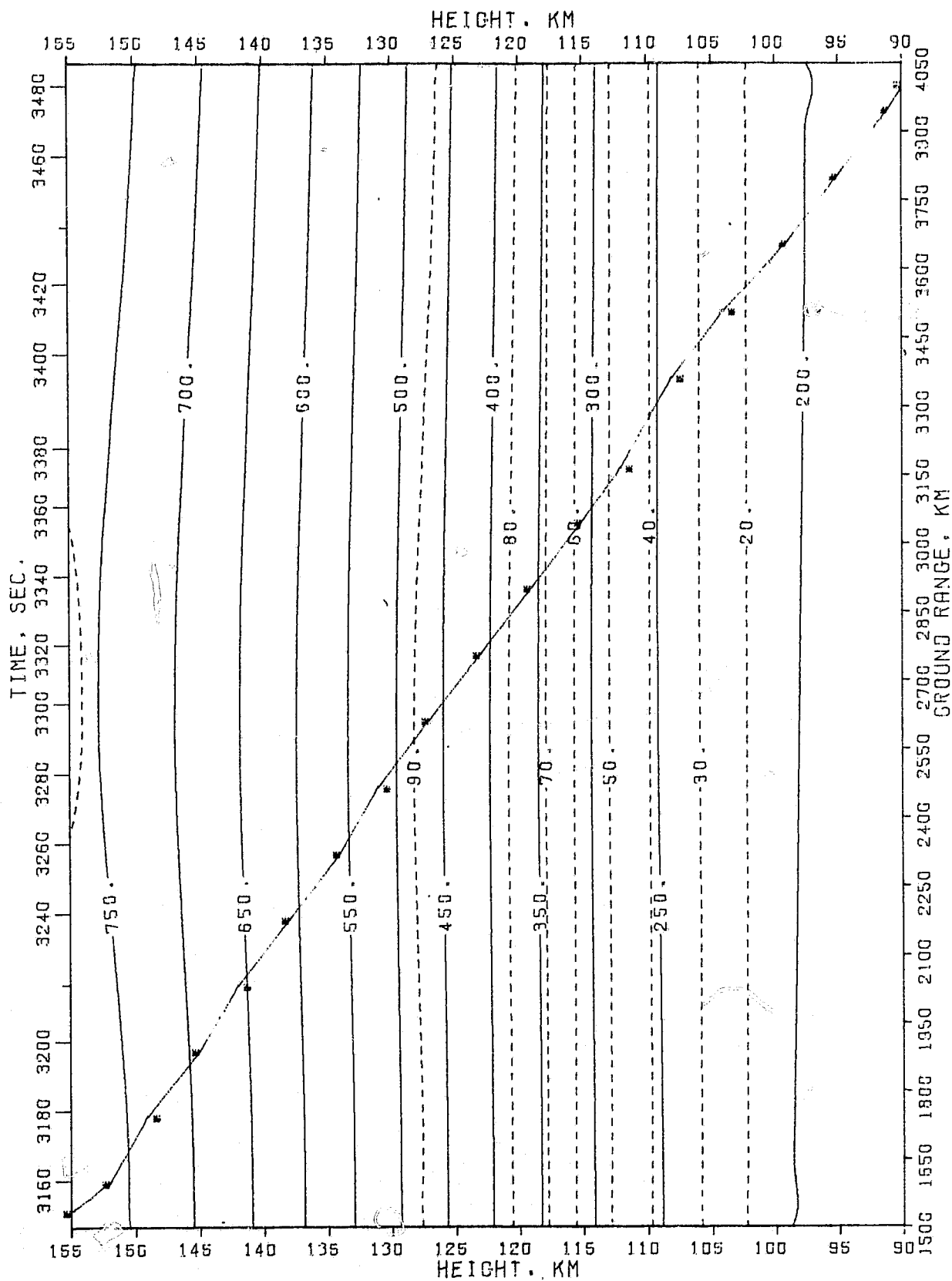
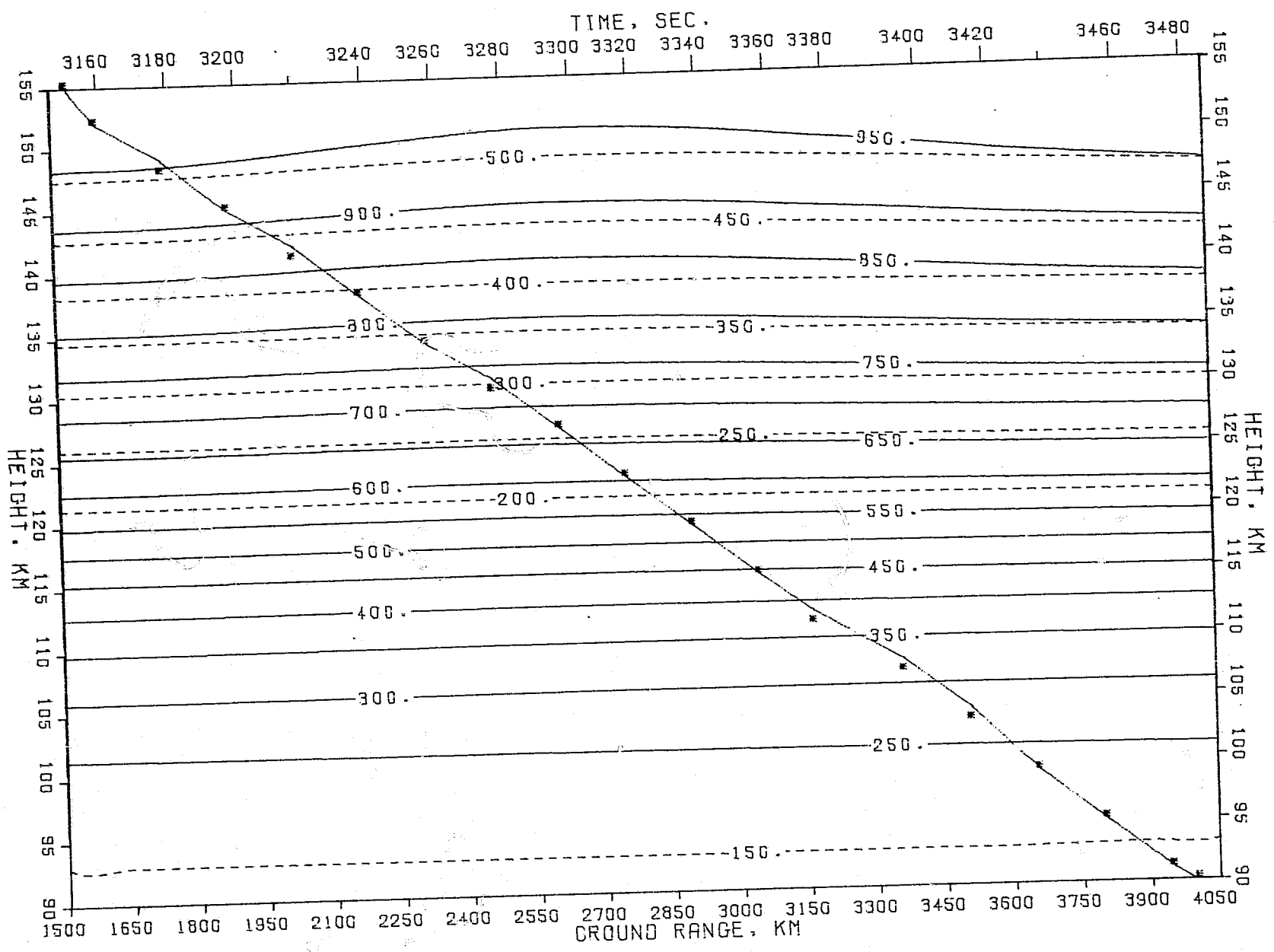


FIG 210

KEY
—— UPPER 99TH PERCENTILE OF TEMPERATURE
- - - - LOWER 99TH PERCENTILE OF TEMPERATURE
* TRAJECTORY
DURING MONTH OF JULY WITH AVERAGE SOLAR ACTIVITY



KEY

- PRESSURE, PERCENT DEV. FROM STD. ATM.
- STD. DEV. OF PRESSURE
- TRAJECTORY
- DURING MONTH OF JULY WITH LOW SOLAR ACTIVITY

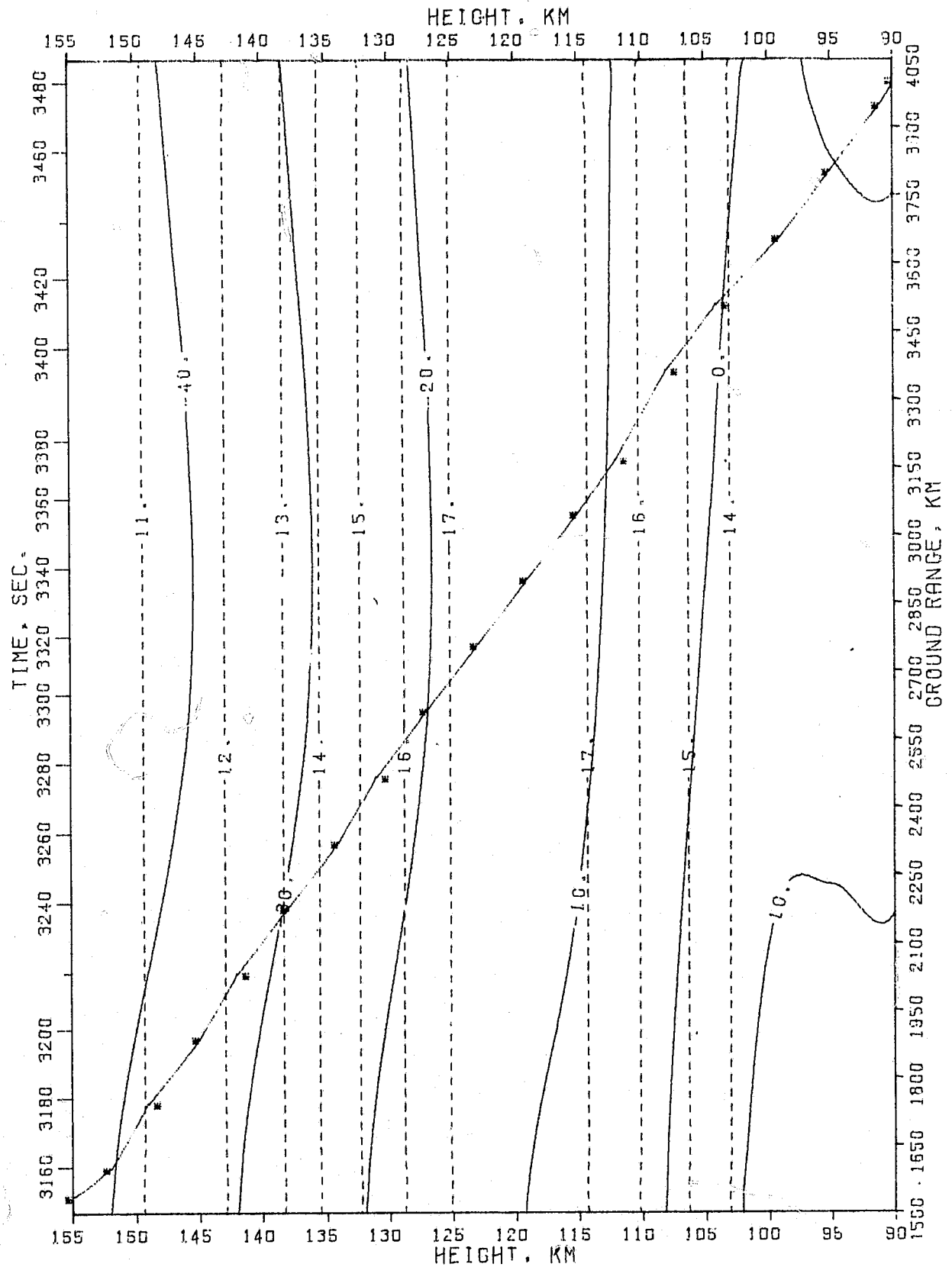


FIG 212

KEY

- UPPER 99TH PERCENTILE OF PRESSURE
- LOWER 99TH PERCENTILE OF PRESSURE
- *----- TRAJECTORY

DURING MONTH OF JULY WITH LOW SOLAR ACTIVITY

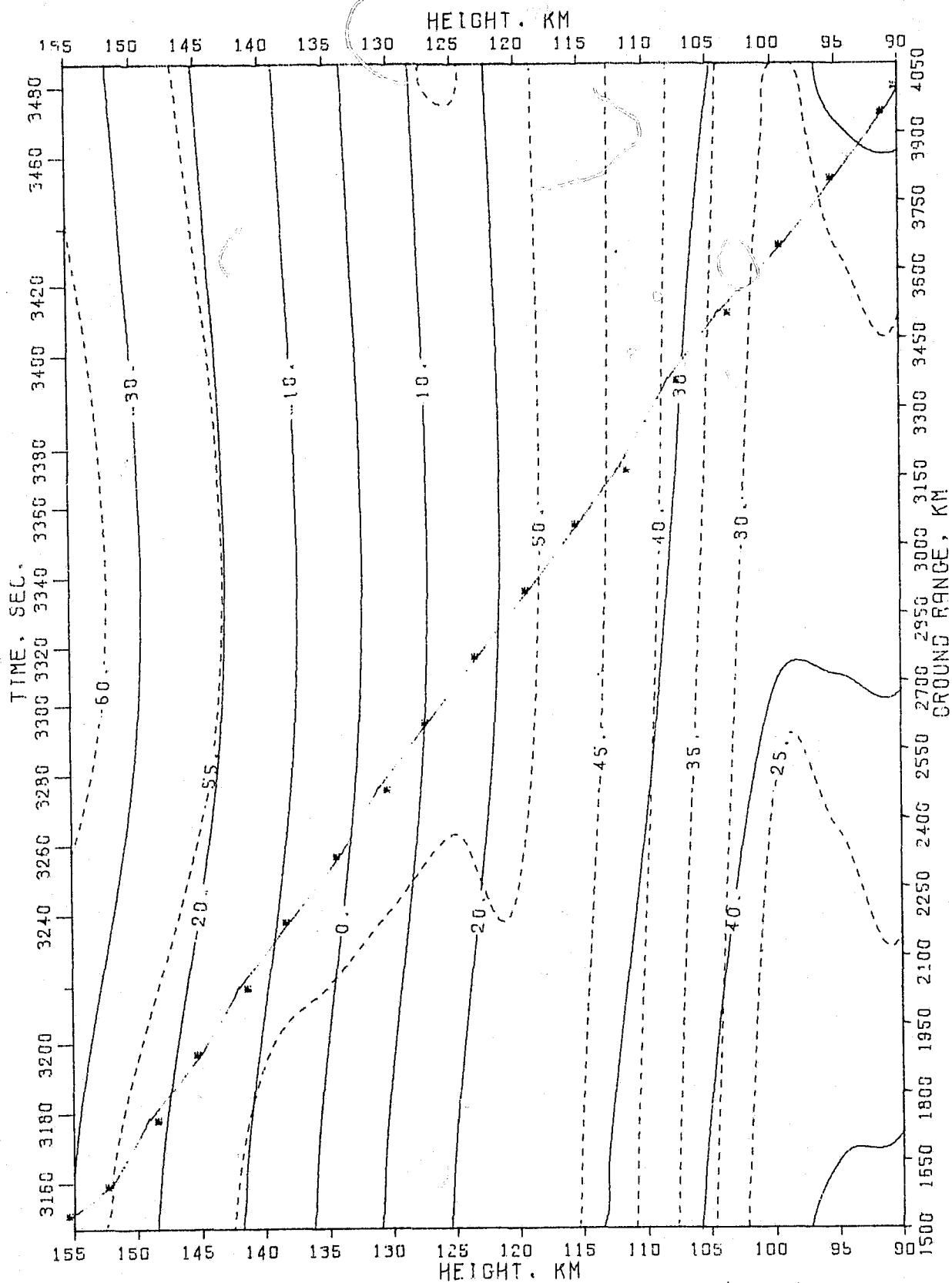


FIG 213

KEY

--- DENSITY PERCENT DEV. FROM STD. ATM.

--- STD. DEV. OF DENSITY

--- TRAJECTORY

DURING MONTH OF JULY WITH LOW SOLAR ACTIVITY

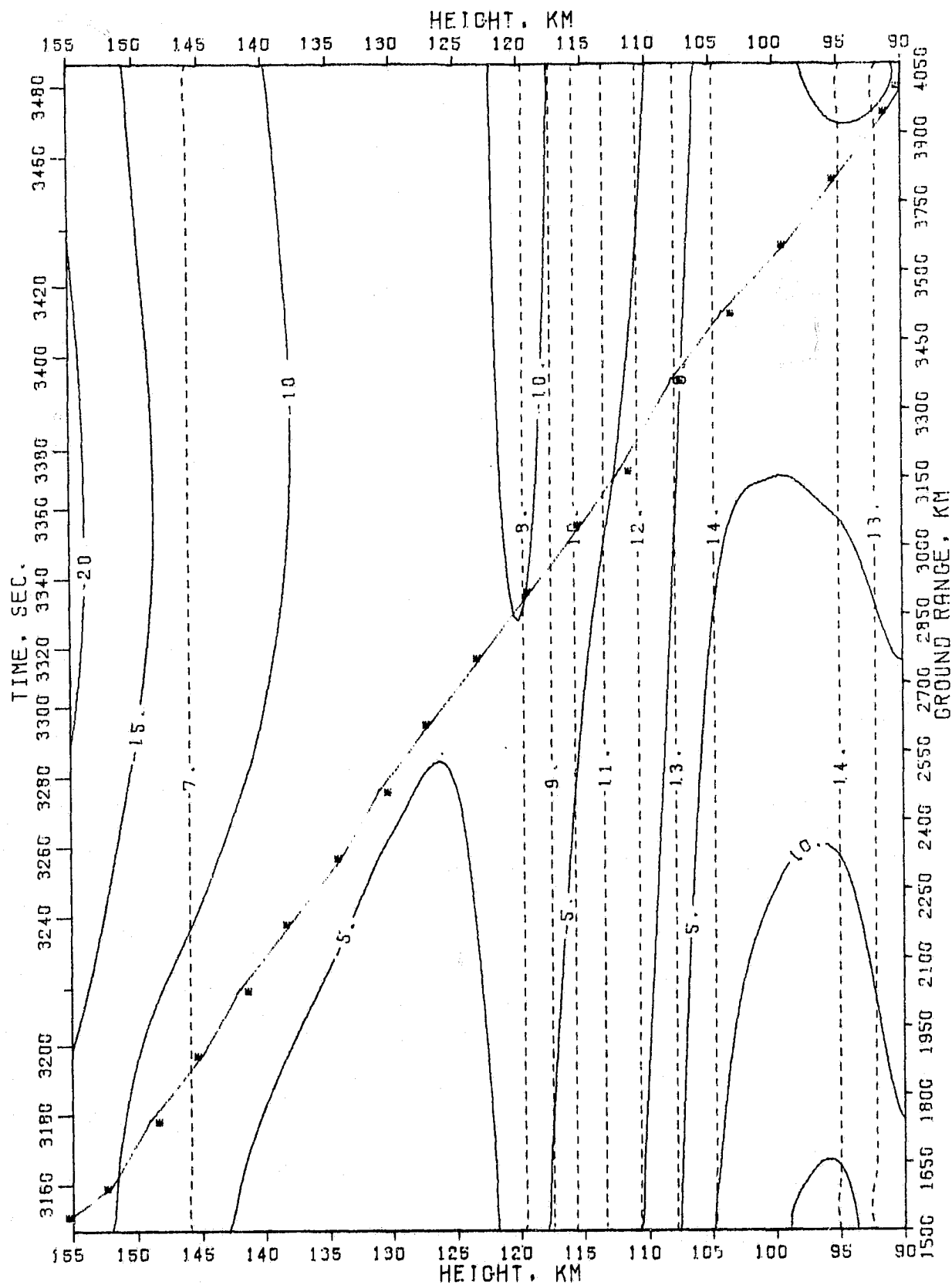


FIG 214

KEY

- UPPER 99TH PERCENTILE OF DENSITY
 - - - - LOWER 99TH PERCENTILE OF DENSITY
 - *— TRAJECTORY
- DURING MONTH OF JULY WITH LOW SOLAR ACTIVITY

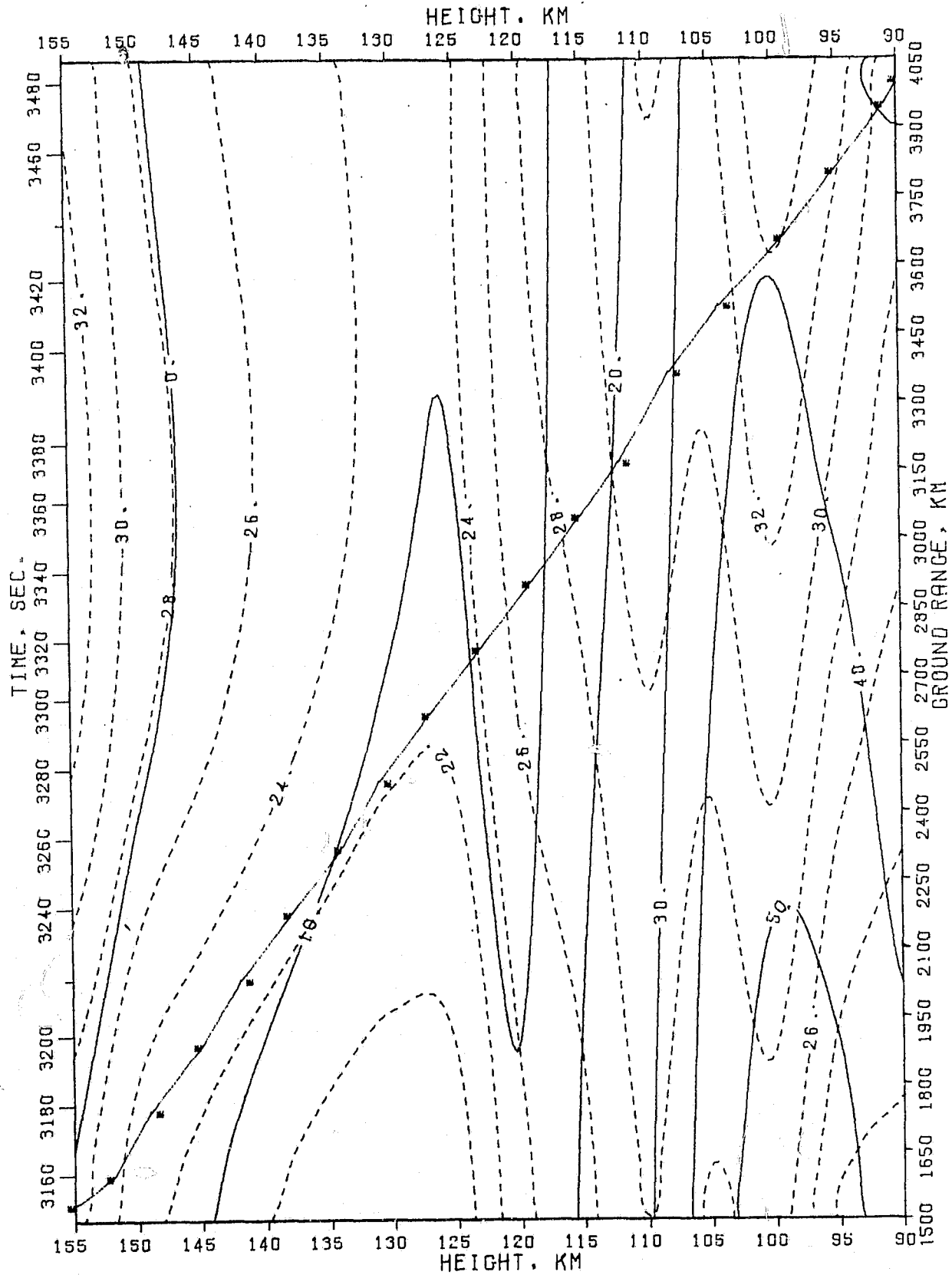
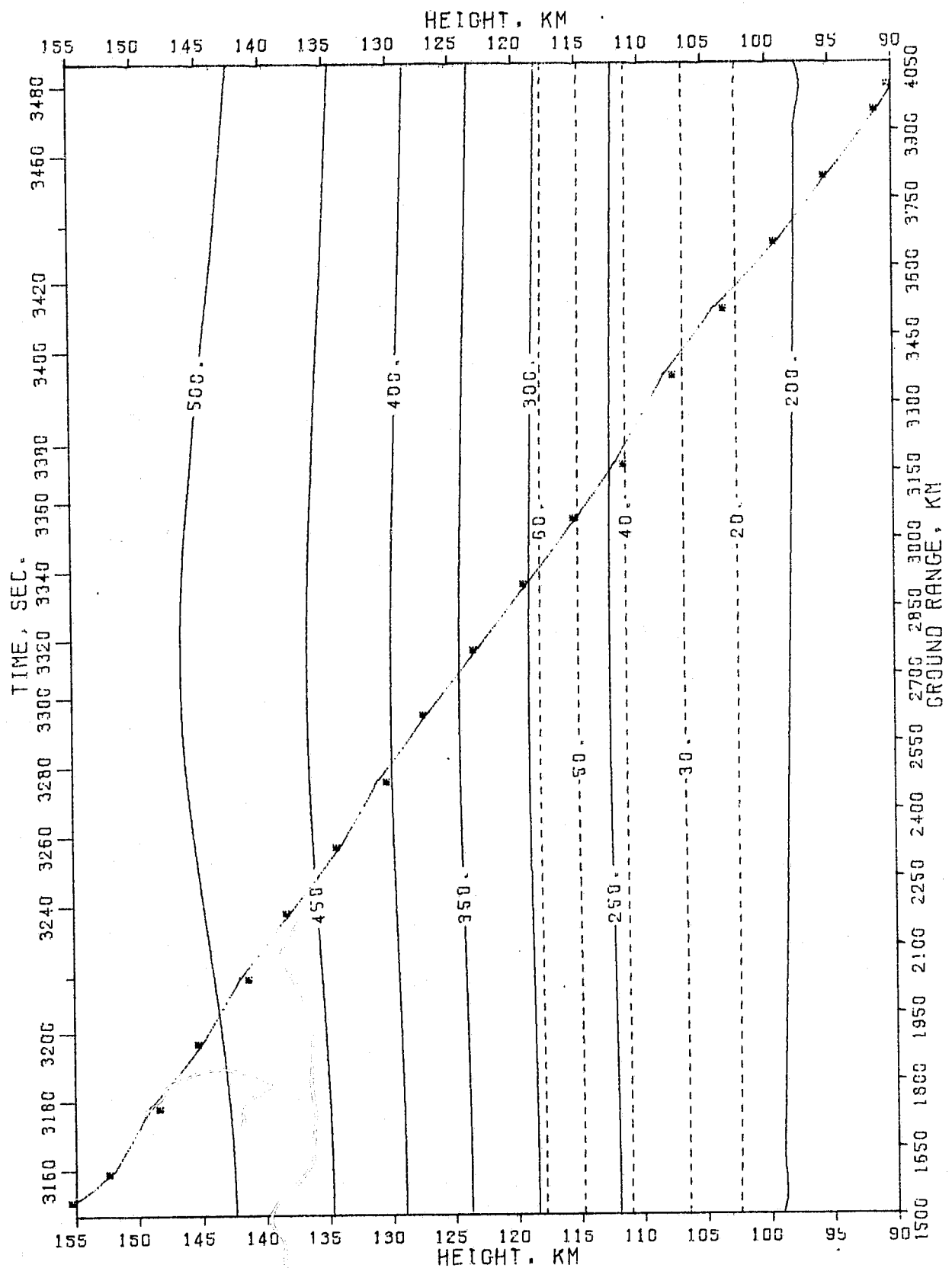


FIG 215

KEY

——— TEMPERATURE DEG. K.
 - - - - STD. DEV. OF TEMPERATURE
 * ——— TRAJECTORY
 DURING MONTH OF JULY WITH LOW SOLAR ACTIVITY



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KEY

- UPPER 99TH PERCENTILE OF TEMPERATURE
- LOWER 99TH PERCENTILE OF TEMPERATURE
- *--- TRAJECTORY
- DURING MONTH OF JULY WITH LOW SOLAR ACTIVITY

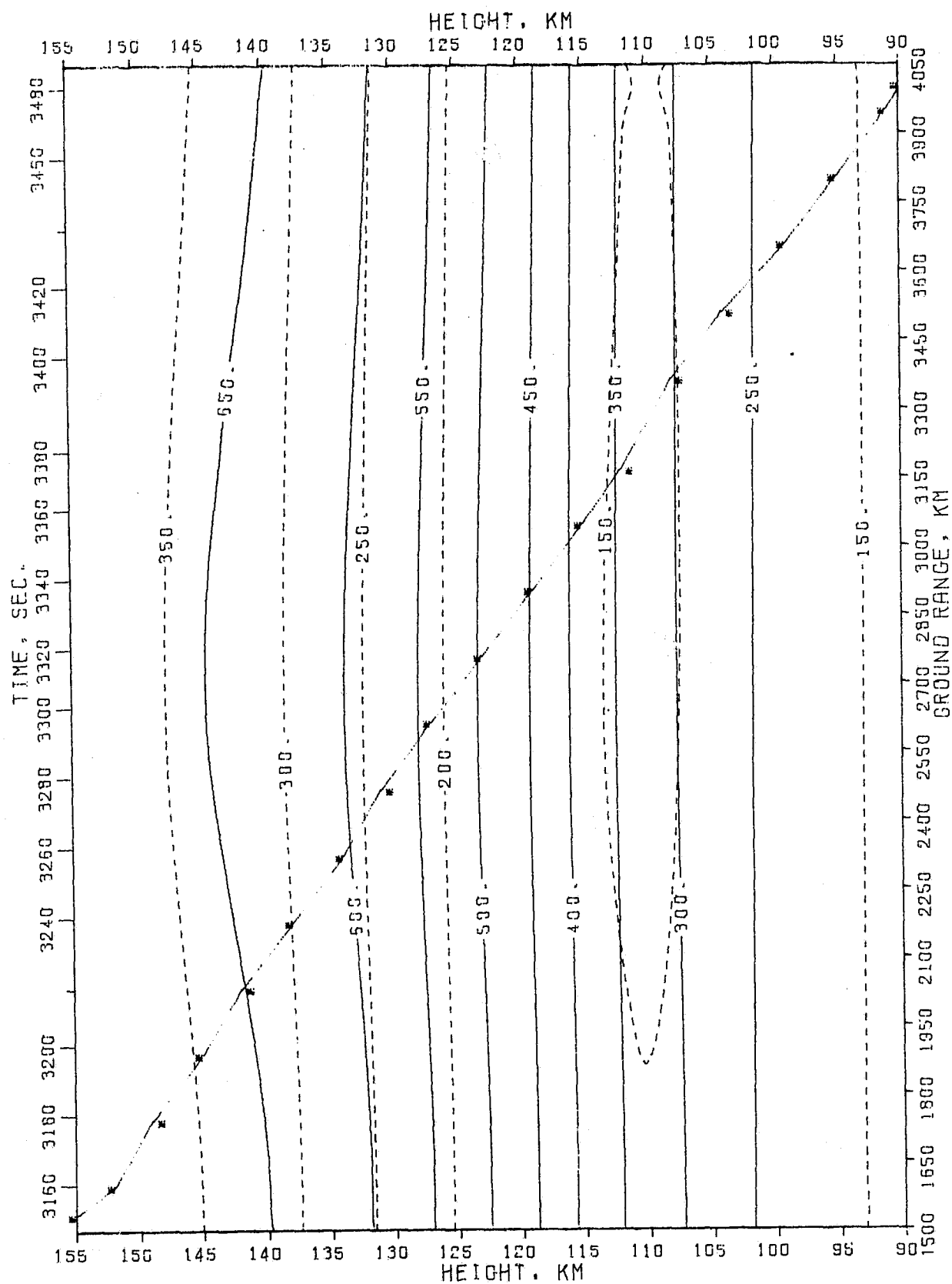
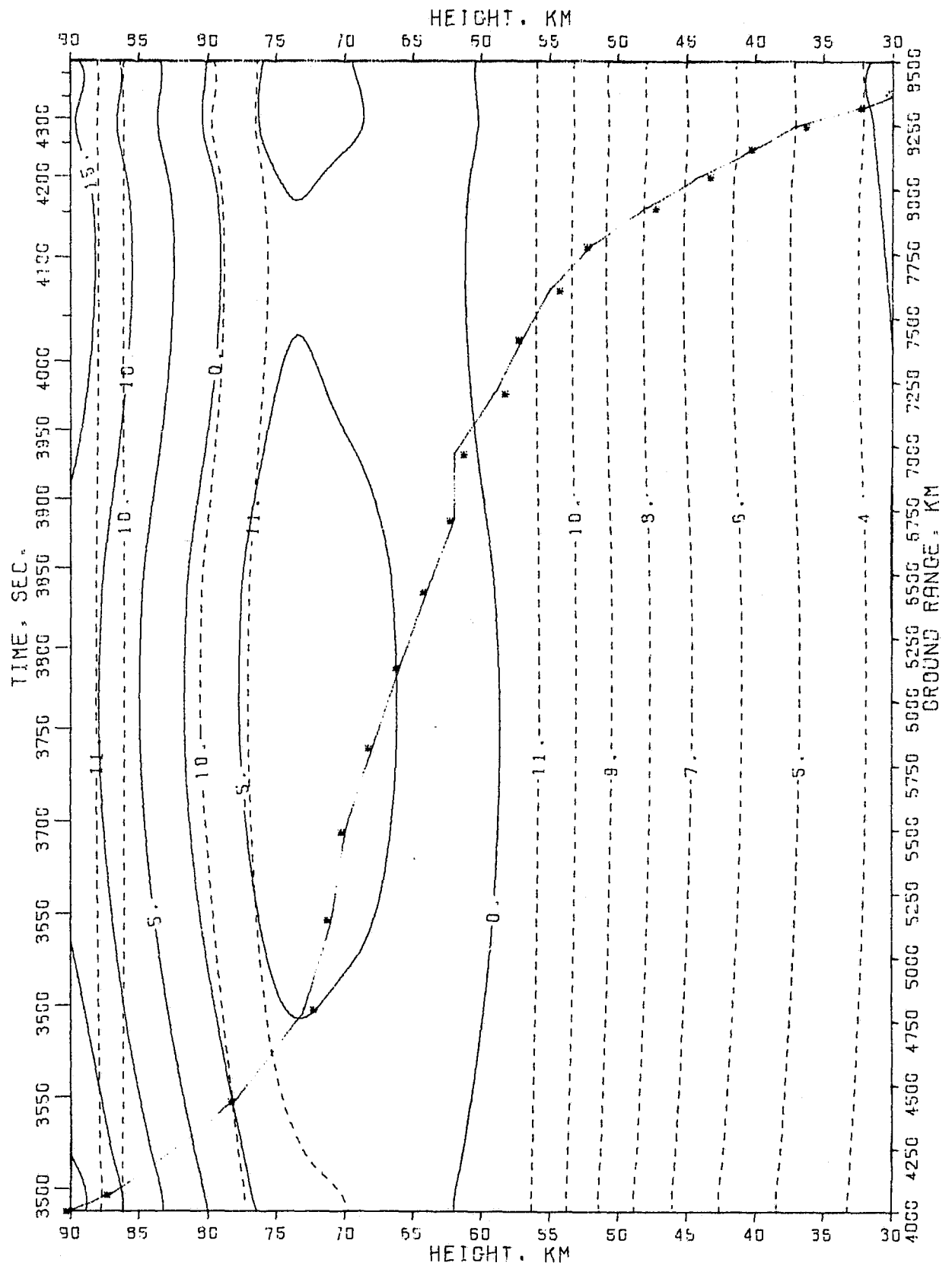
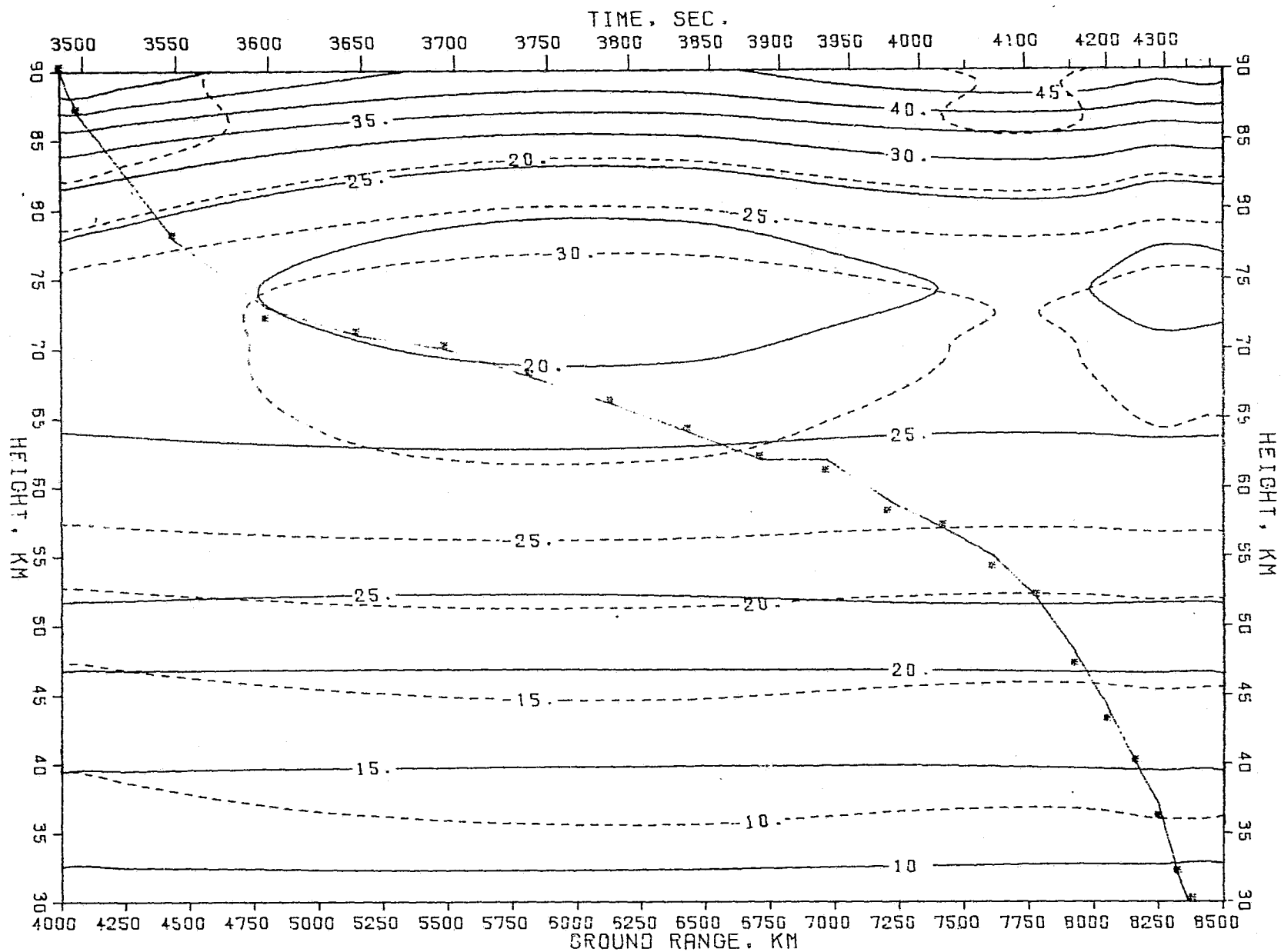


FIG 217

KEY

- PRESSURE. PERCENT DEV. FROM STD. ATM.
- - - STD. DEV. OF PRESSURE
- * TRAJECTORY
- DURING MONTH OF OCTOBER





KEY

— UPPER 99TH PERCENTILE OF PRESSURE

- - - LOWER 99TH PERCENTILE OF PRESSURE

x TRAJECTORY

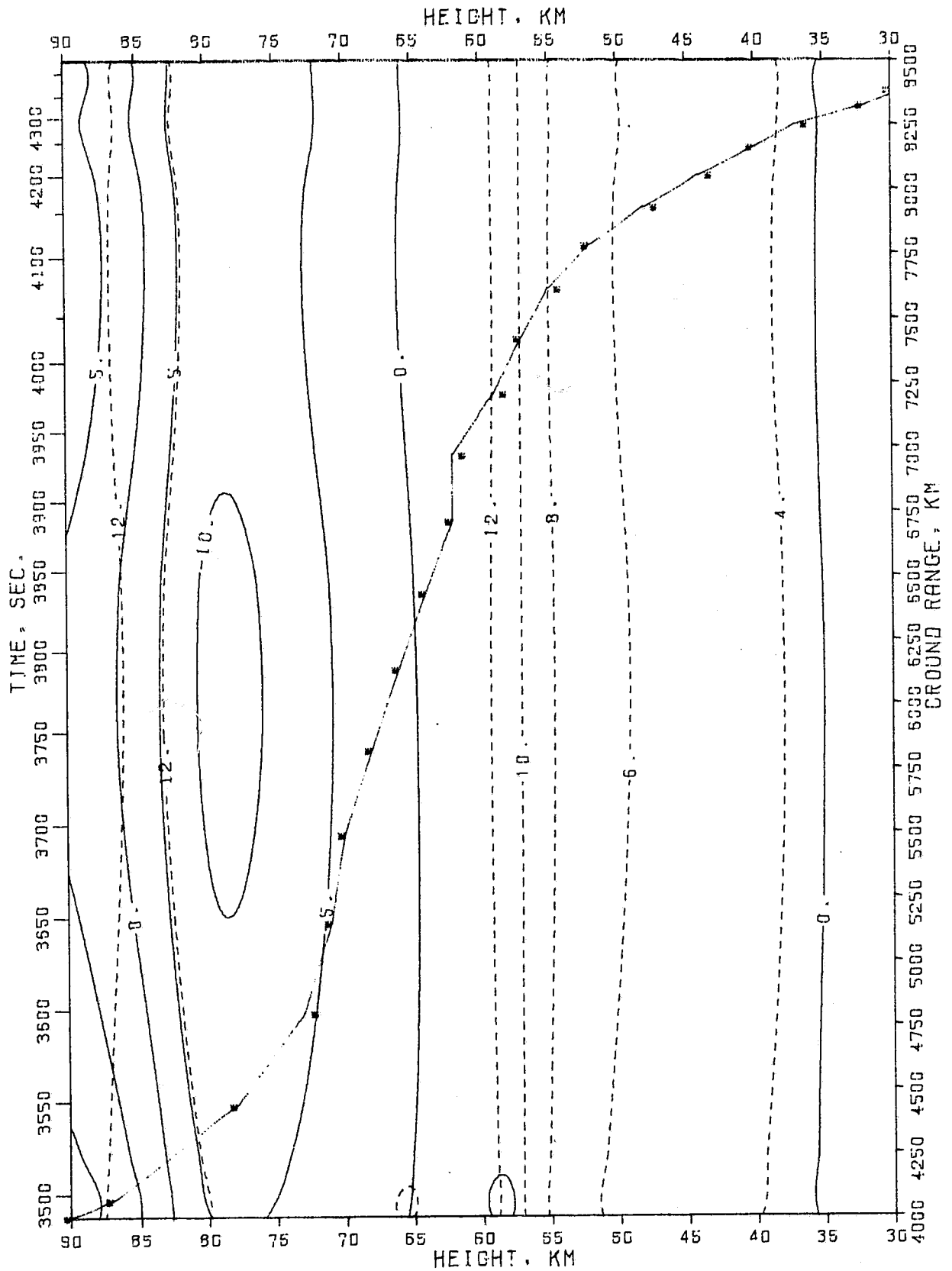
DURING MONTH OF OCTOBER

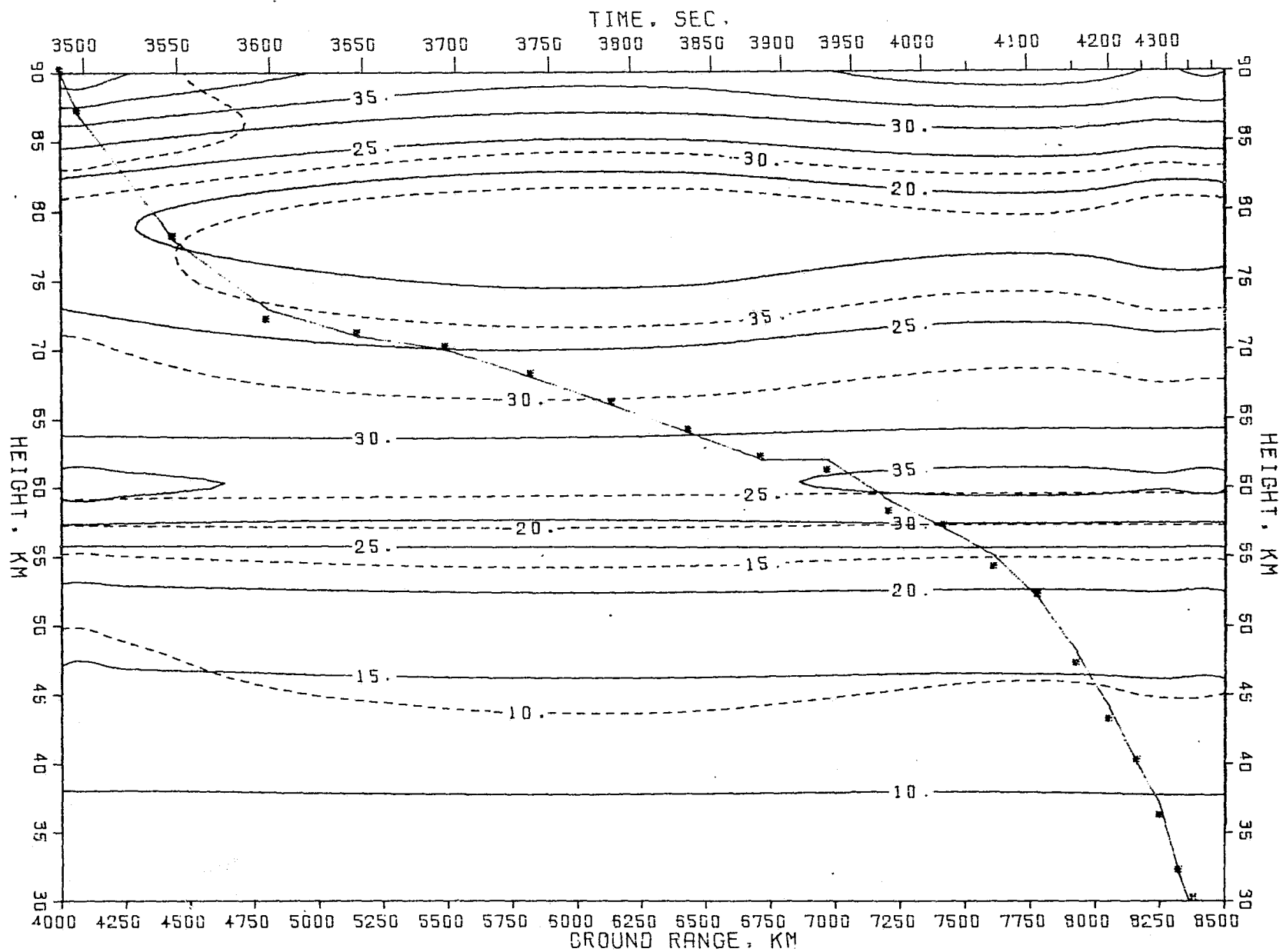
FIG 218

FIG 219

KEY

- DENSITY PERCENT DEV. FROM STD. ATM.
- - - STD. DEV. OF DENSITY
- TRAJECTORY DURING MONTH OF OCTOBER





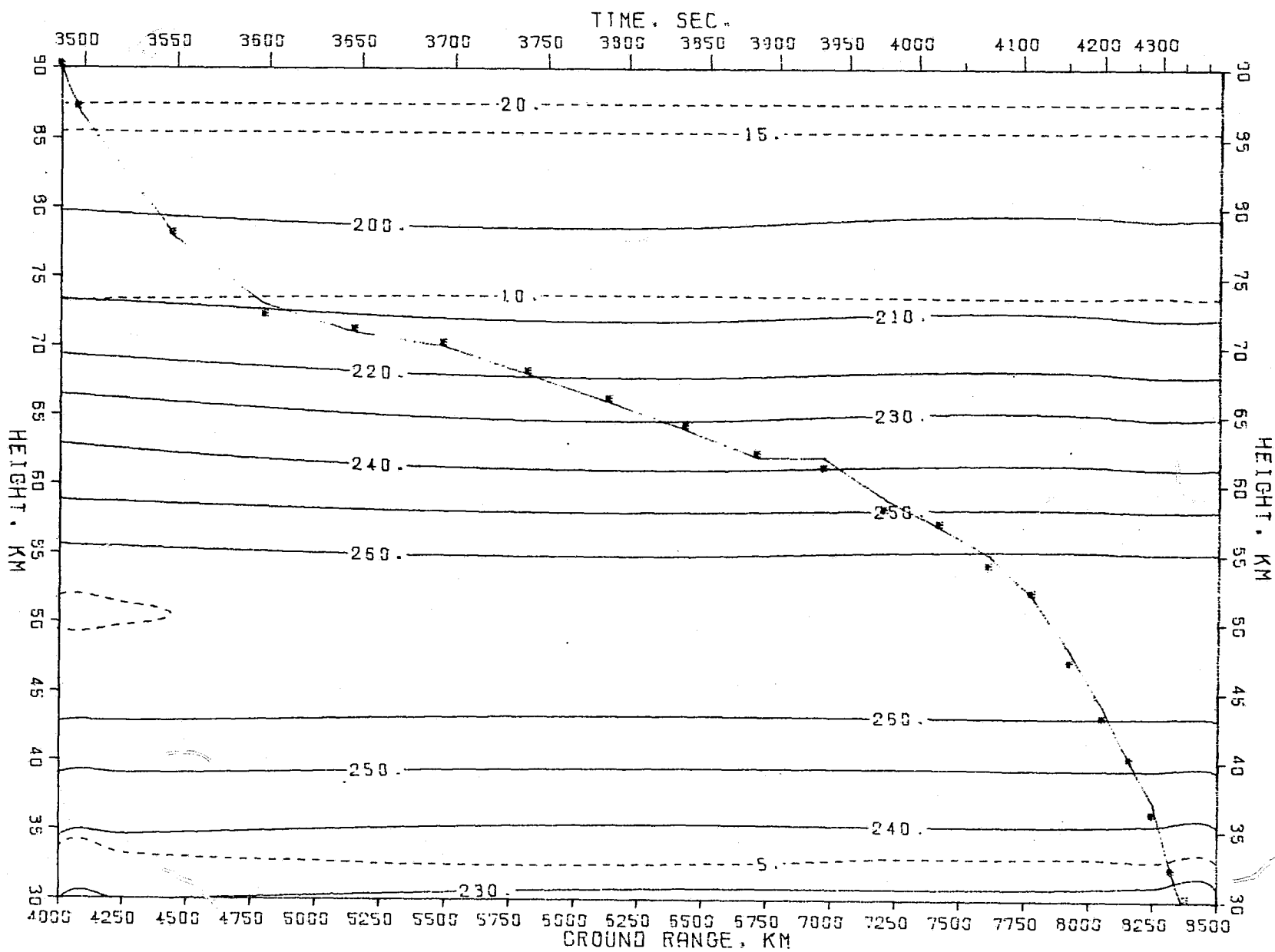


FIG 221

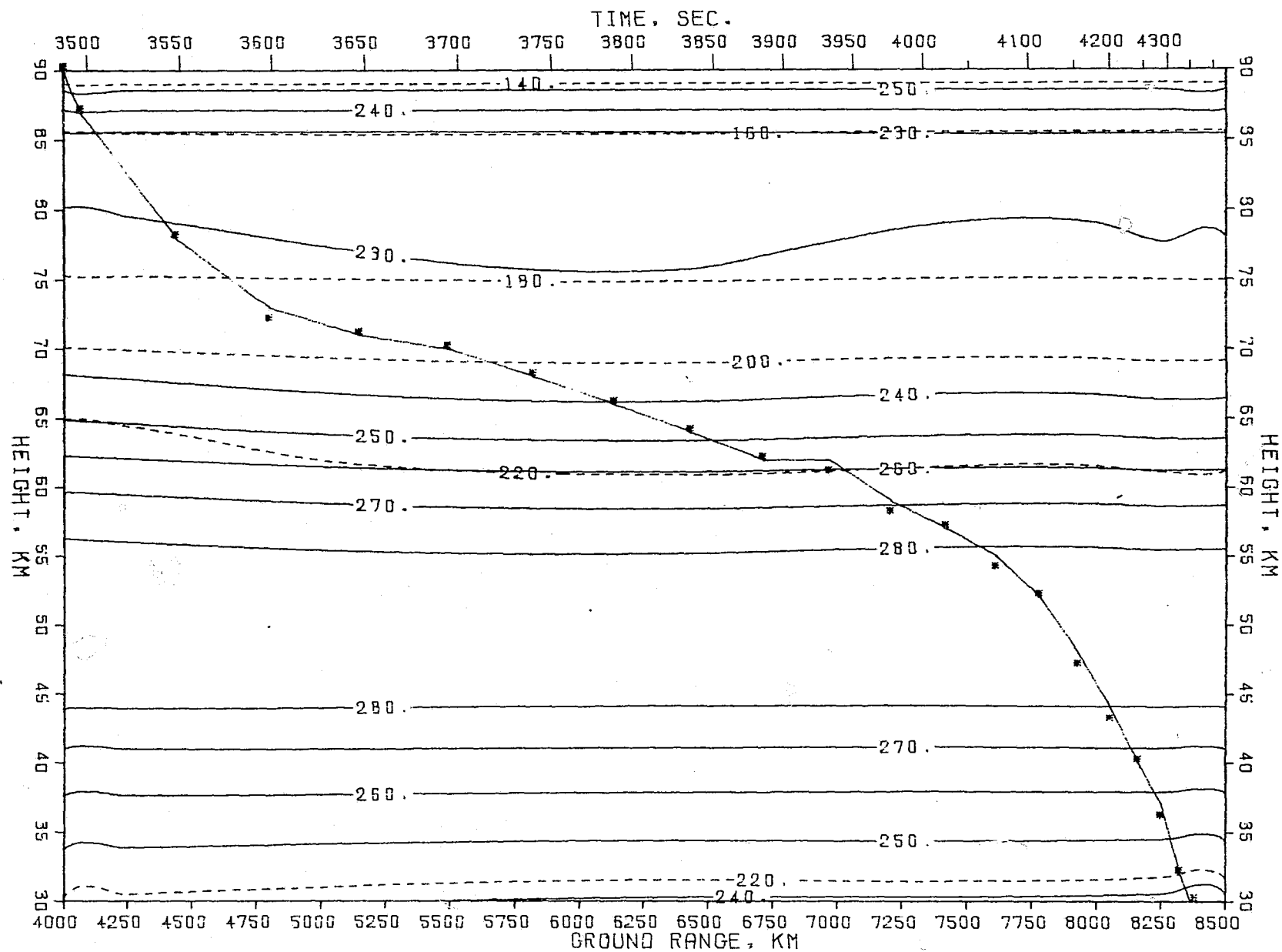
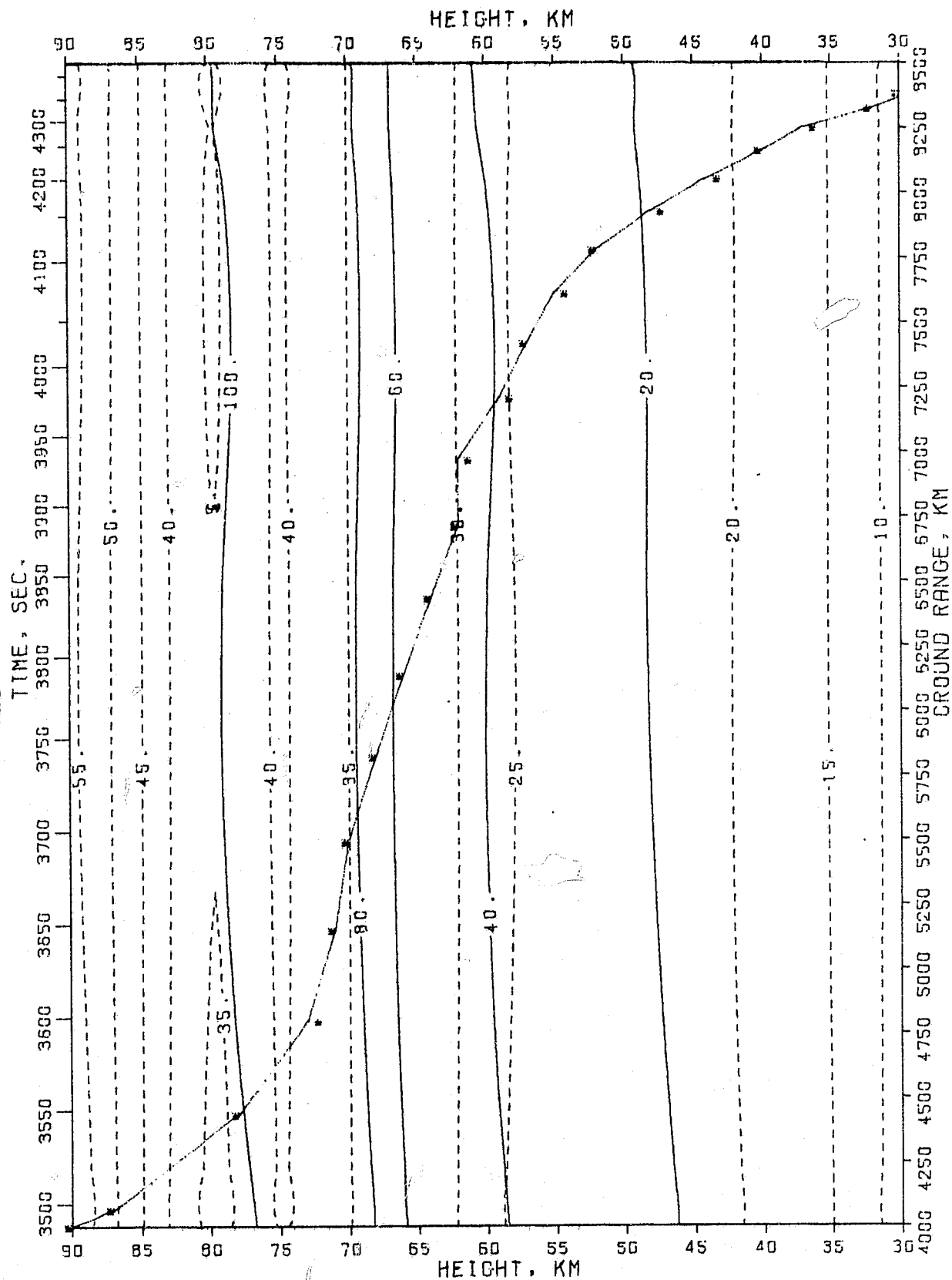


FIG. 222

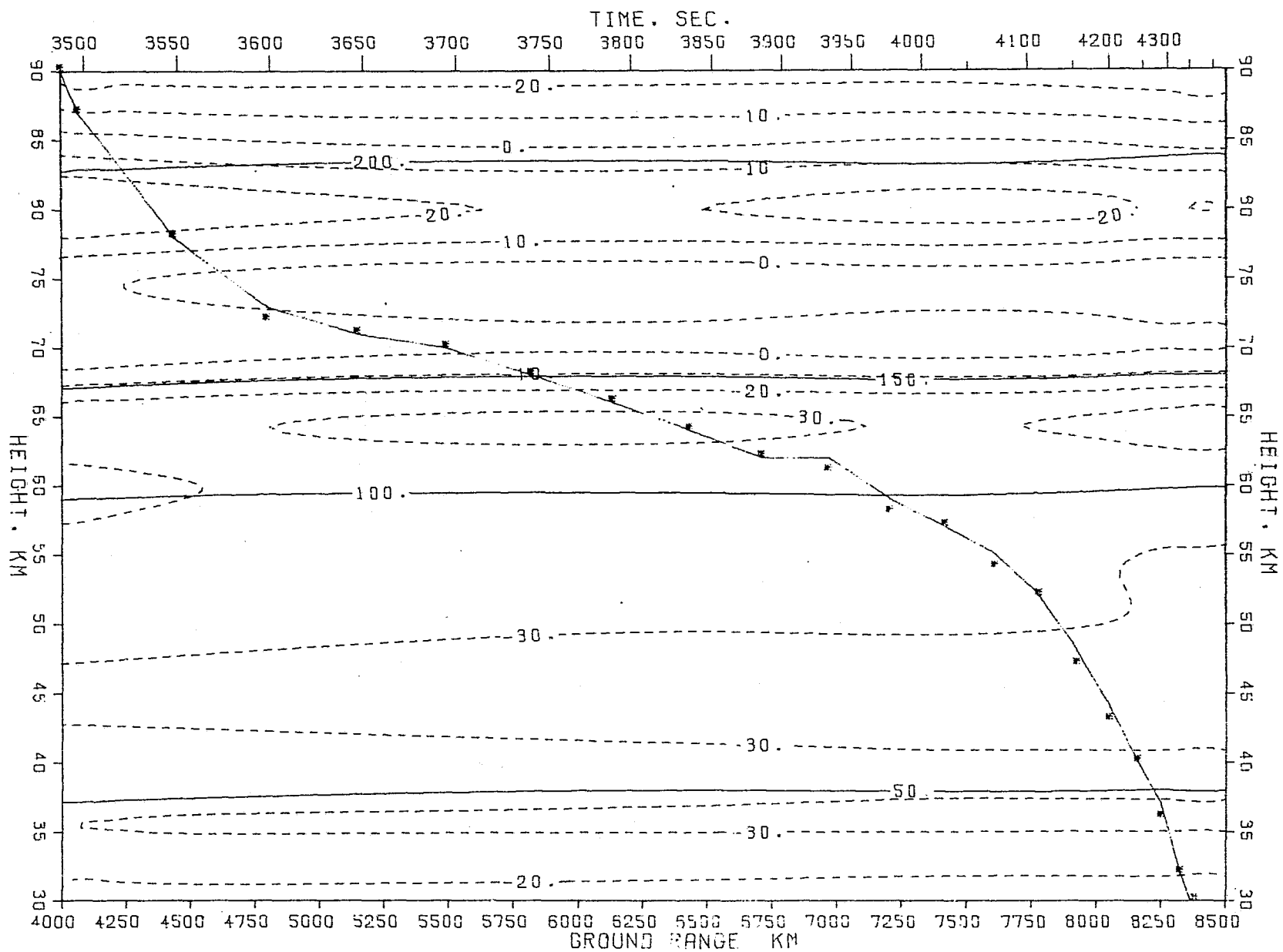
FIG 223

KEY

- EASTWARD WIND GEOSTROPHIC MONTHLY MEAN, M/S.
- - - STD. DEV. OF EASTWARD WIND
- TRAJECTORY
- DURING MONTH OF OCTOBER



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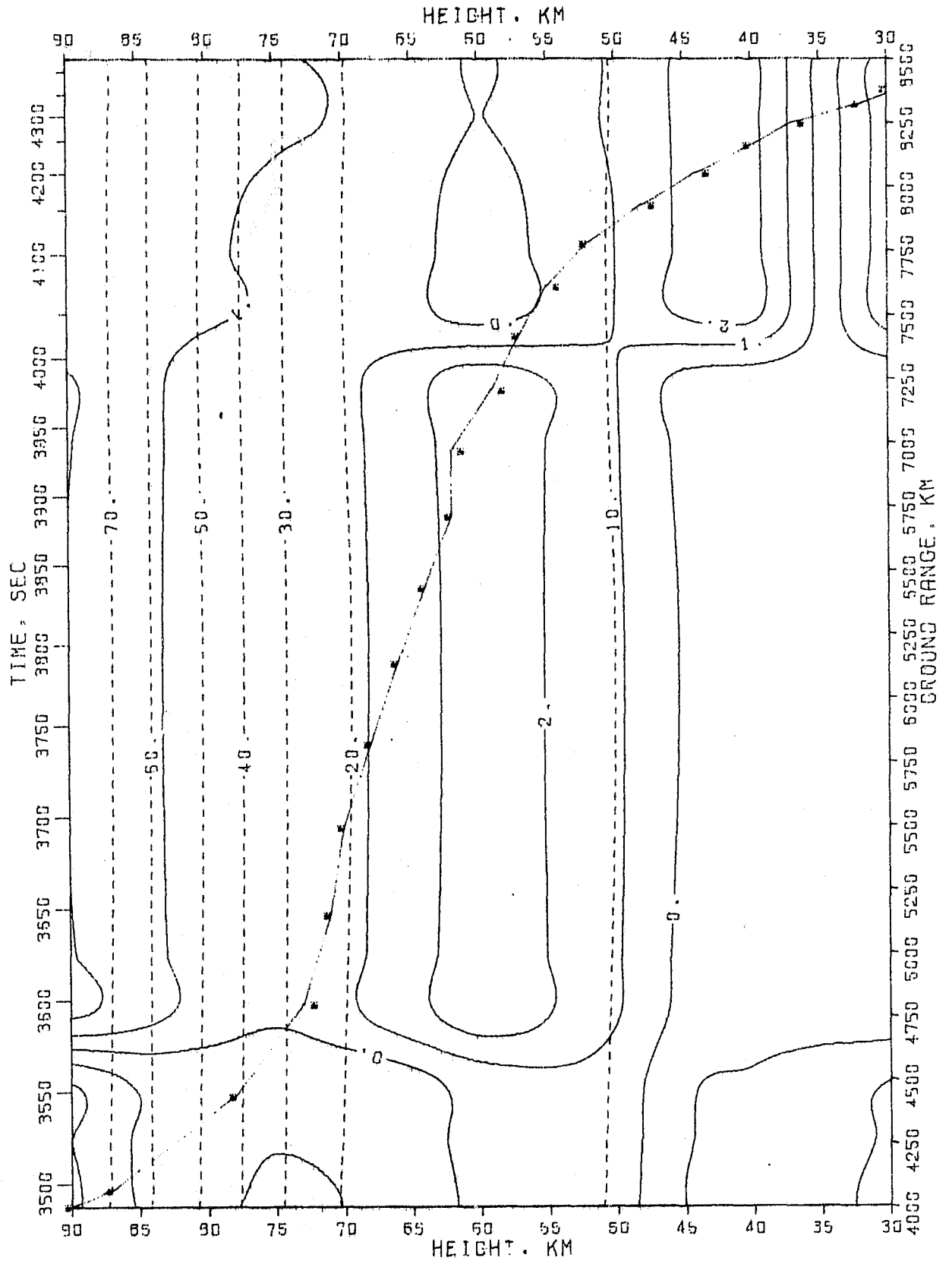


KEY
 --- UPPER 99TH PERCENTILE OF EASTWARD WIND
 --- LOWER 99TH PERCENTILE OF EASTWARD WIND
 * TRAJECTORY
 DURING MONTH OF OCTOBER

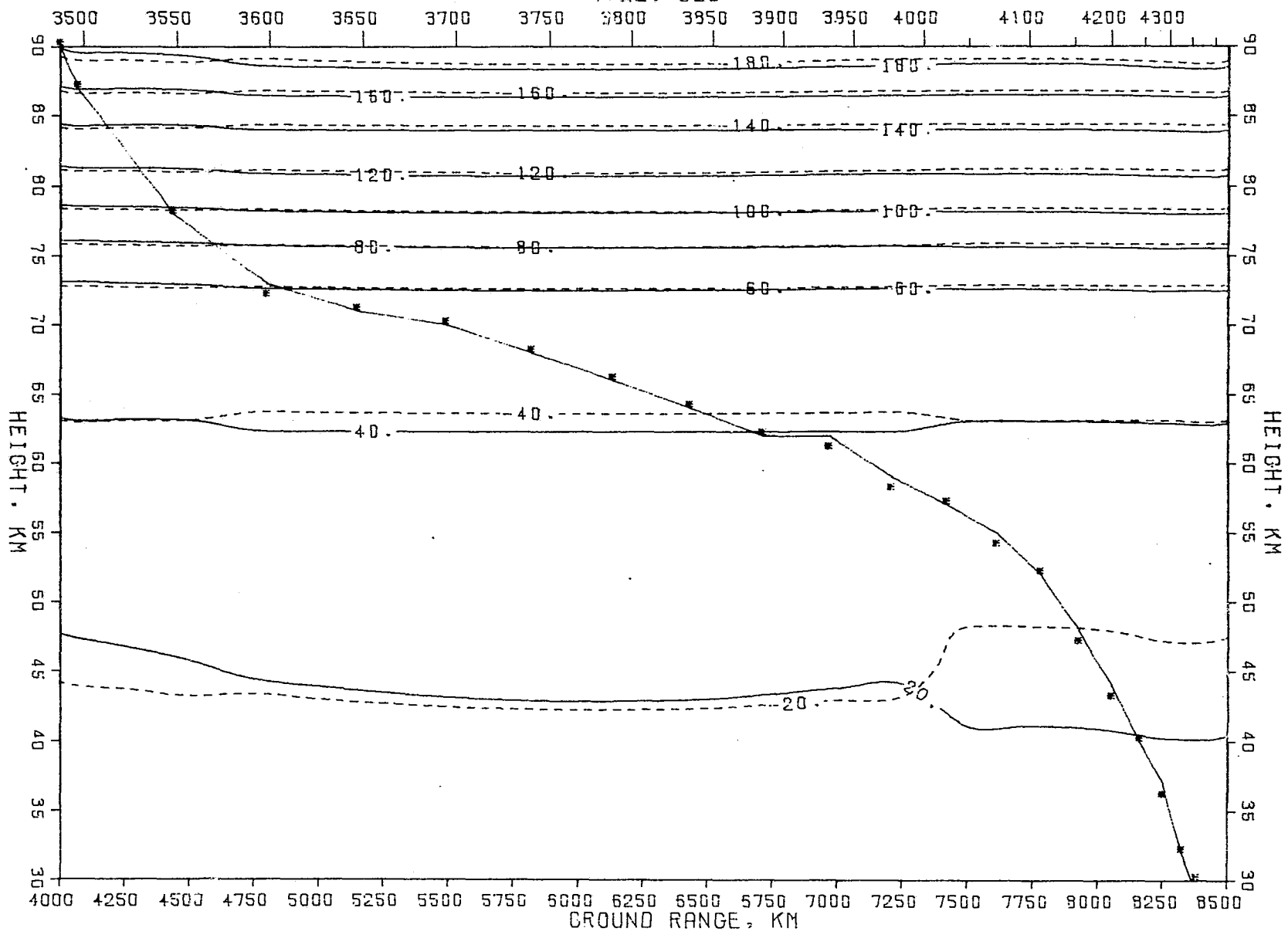
FIG 224

KEY

- NORTHWARD WIND GEOSTROPHIC MONTHLY MEAN, M/S.
- STD. DEV. OF NORTHWARD WIND
- TRAJECTORY
- DURING MONTH OF OCTOBER



TIME, SEC.



KEY

— UPPER 99TH PERCENTILE OF NORTHWARD WIND TRAJECTORY

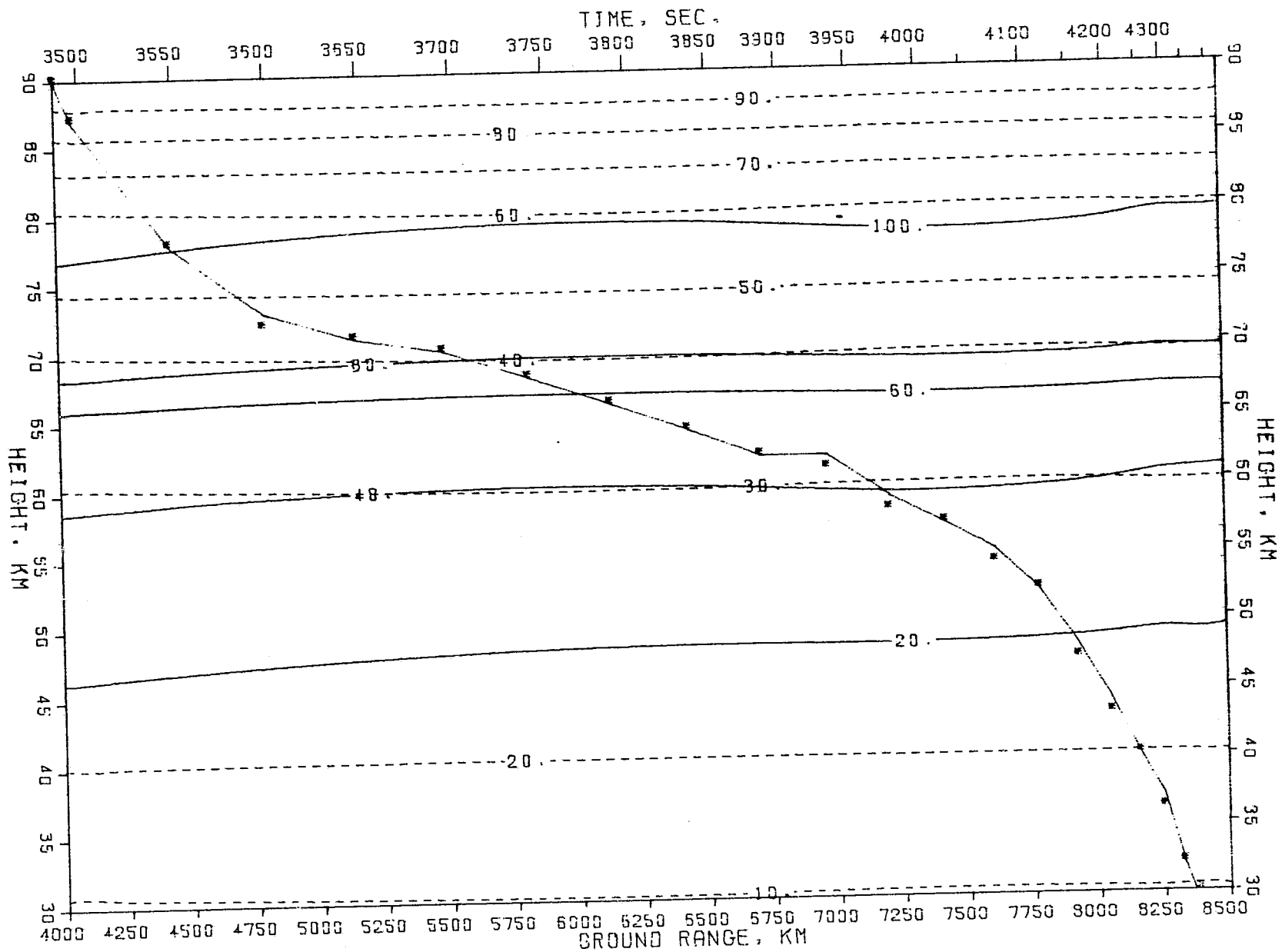
- - - LOWER 99TH PERCENTILE OF NORTHWARD WIND TRAJECTORY

DURING MONTH OF OCTOBER

FIG 226

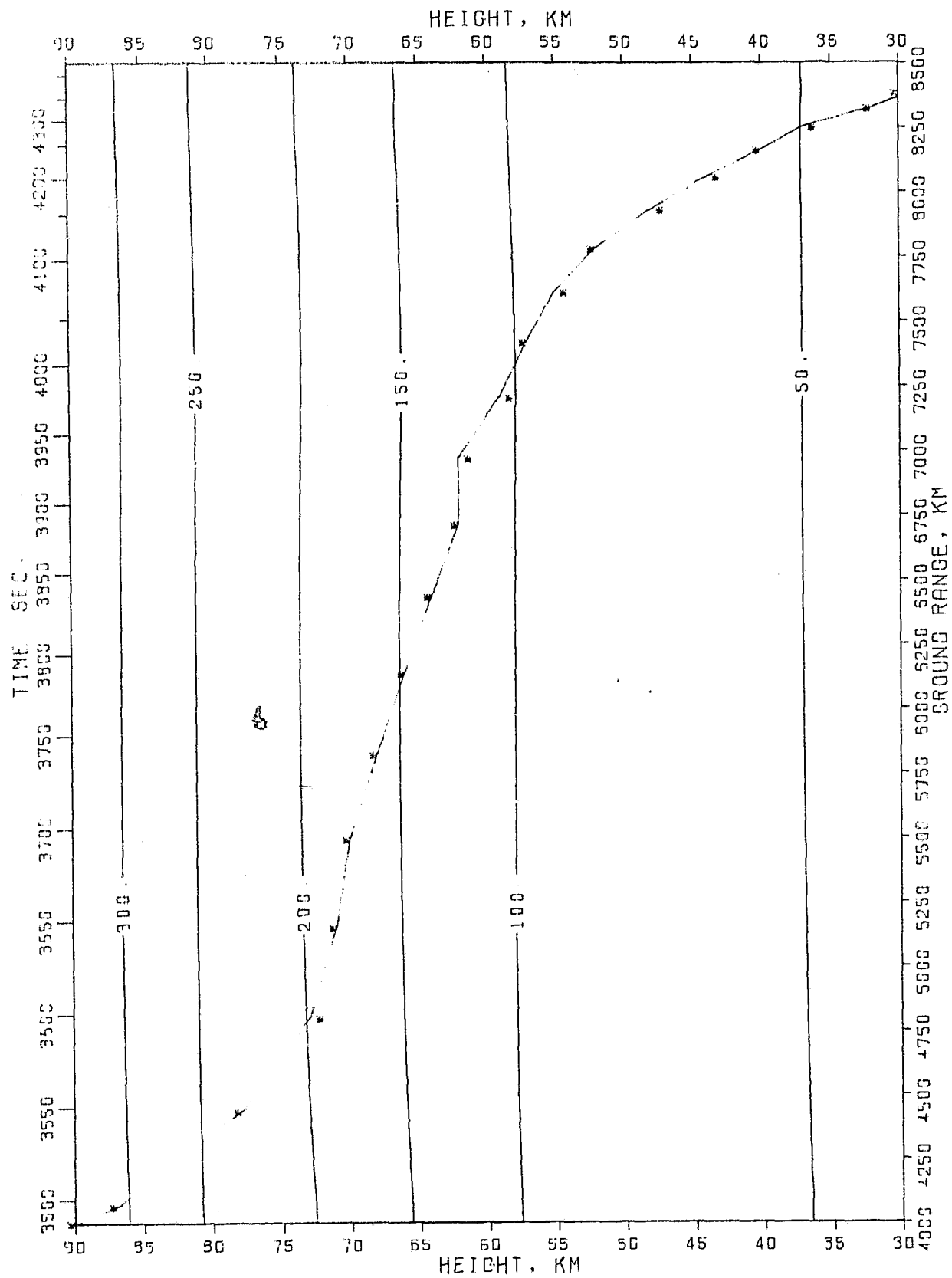
FIG 227

KEY
 — WIND SPEED, M/S.
 - - - STD. DEV. OF WIND SPEED
 * TRAJECTORY
 DURING MONTH OF OCTOBER



KEY

- UPPER 99TH PERCENTILE OF WIND SPEED
 - LOWER 99TH PERCENTILE OF WIND SPEED
 - * TRAJECTORY
- DURING MONTH OF OCTOBER



APPENDIX A

As described by O. E. Smith in NASA TMX-73319, the probability distribution of wind speeds is a generalized Rayleigh distribution (coming from a bi-variate Gaussian distribution of wind components). If we assume for convenience that $\sigma_u = \sigma_v$ and that the correlation $\langle uv \rangle$ is zero, then the λ value corresponding to a given probability p is, from equation (12) of NASA TMX-73319

$$\lambda^2 = -2 \ln (1 - p) \quad (\text{A-1})$$

where λ^2 is given in terms of \bar{u} , \bar{v} , and σ by

$$\lambda^2 = [(u - \bar{u})^2 + (v - \bar{v})^2] / \sigma^2 \quad (\text{A-2})$$

i.e. λ is the non-dimensional radius of the circle enclosing p fraction of the wind speed vectors. Since the wind vector (\bar{u}, \bar{v}) is the resultant wind, with speed V_r , the upper speed corresponding to probability p would be $V_r + \lambda\sigma$ and the lower speed would be $V_r - \lambda\sigma$. For $p = 99\%$ λ would be 3.035 or in terms of σ_c , where $\sigma_c = \sqrt{\sigma_u^2 + \sigma_v^2} = \sqrt{2} \sigma$ the upper and lower limits on speed would be

$$V_{\pm} = V_r \pm 2.146 \sigma_c \quad (\text{A-3})$$

Since the upper and lower percentile wind speeds were computed from equation (3) computed by

$$V_{\pm} = V_r \pm 2.326 \sigma_c \quad (\text{A-4})$$

this corresponds to a λ value of 3.289 or a probability p of about 99.6%. Note that when V_r is negative, zero is used as the lower 99 percentile speed.